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AMERICAN MACHINIST

May 1, 1940

Step-Up—*From pilot plant to production line is the course of General Motors' new automatic transmission*

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Important Announcement

FOR ALL

Metal-Working Production Executives

AMERICAN MACHINIST

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THE MODERNIZATION NUMBER

MAY 29, 1940

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also

A Special Inventory of Arsenal Equipment. A Plant-to-Plant Survey of Buying . . . and Extensive Interpretative Articles.

WHAT'S IN THIS ISSUE

RESEARCH

Every now and then folks ask how we compile data for the special materials sections that crop up regularly in AMERICAN MACHINIST. Since there's one in this number, dealing with magnesium alloys, now is as good a time as any to let down our editorial hair and tell how it's done. After all, it's no secret, and it does prove the life of an editor isn't the easiest in the world.

About a year in advance each staff man is assigned one of these special sections. From that moment on the subject keeps kicking around in the back of his mind. Every time he goes into a plant, or talks to a production man, or spots a catalog on his topic, he files the information away in his head and in his desk drawer. About four months from his deadline he really buckles down to the task of getting facts and figures, which involves a tremendous amount of letter writing, traveling, coaxing and digging.

Eventually he assembles enough data to fill an encyclopedia. In his own way he then boils down this material into thirty pages or so of rough copy and tables, polishes it up a bit, and sends out copies to authorities for checking. When these come back (usually with remarkably few corrections) they are condensed a bit, edited for greater clarity, tables simplified, and squeezed—and we do mean squeezed—into the allotted space. From then on it's mostly a mechanical problem, involving frequent battles with the printer.

As in many another job of this sort, it's hard to know where to stop. As the deadline draws closer, more and more things that previously weren't planned on *must* get in. At this point making the section complete, consistent and concise requires a mental marvel. But most editors seem to be able to crash through in a pinch, take an hour off for a nervous breakdown, and tackle the next job. Right now we doff our hat to associate editor Ben C. Brosheer, who's responsible for "The Working of Magnesium Alloys" on page 291. If you like it, tell your friends; if not, tell us, as they say on menus.

TORCH TIPS

Not alone in his labors is Mr. Brosheer. John Haydock, our managing editor, has been doing much the same sort of research on design of jigs for gas welding. After twice the trouble you'd think he'd meet, he got the data he wanted, revealed it to the International Acetylene Association a couple of weeks ago, and summarized it in the article beginning on the next page. It's illustrated with plenty of photographs, too.

SHIFTLESS

If you've bought a 1940 Oldsmobile with the automatic transmission, you don't have to worry about fiddling with a gearshift lever or pumping a clutch pedal. The device making possible your emancipation is one of those engineering triumphs which usually bring with them a few manufacturing headaches. Since the job involves lots of different kinds of problems, the story starting on page 280, by R. W. Warnock, factory manager of G.M.'s Detroit Transmission Division, ought to prove both interesting and informative. See if you don't agree.

BLAINE STUBBLEFIELD

MEET "STUBB"

For some time now Blaine Stubblefield has been digging up Washington dirt and interpreting Capitol news in "Watching Washington," which you'll find this time on page 306h. "Stubb" had technical training in the Army, was a commissioned pilot in the Air Corps and has served as flying instructor. A graduate of the University of Idaho in journalism and a post-graduate student at the University of Washington, he's also been associated with industrial designers in New York City and served as account executive for a New York advertising agency. Through all his meanderings he's kept in touch with just about everything going on in aircraft circles, which is one reason why you've been reading aircraft industry lowdown in AMERICAN MACHINIST recently. So we feel it's high time you and "Stubb" were getting acquainted. He's as dapper as he looks, even on Washington's swelteringest days. His tan is more pronounced than in the picture. He insists it's the result of a luxurious stay in Miami, but when his colleagues in the Washington office murmur something about a sun lamp, he promptly changes the subject.

KINKS

On page 283 you'll find another recurrent feature which has proved popular. This is the "Short Cuts for the Small Shop" page which presents handy kinks picked up by A. H. Waychoff in his rambles through Arizona and points west. If you'd like to oil taps better or save scrap solder he's right there with the answers.

BAR TOOLING

Installment six of the turret lathe tooling series, which appears on page 284, discusses tooling set-ups for bar work. In it J. R. Longstreet and W. K. Bailey, of Warner & Swasey, give some more information to help get the utmost out of turret lathes.

COORDINATES

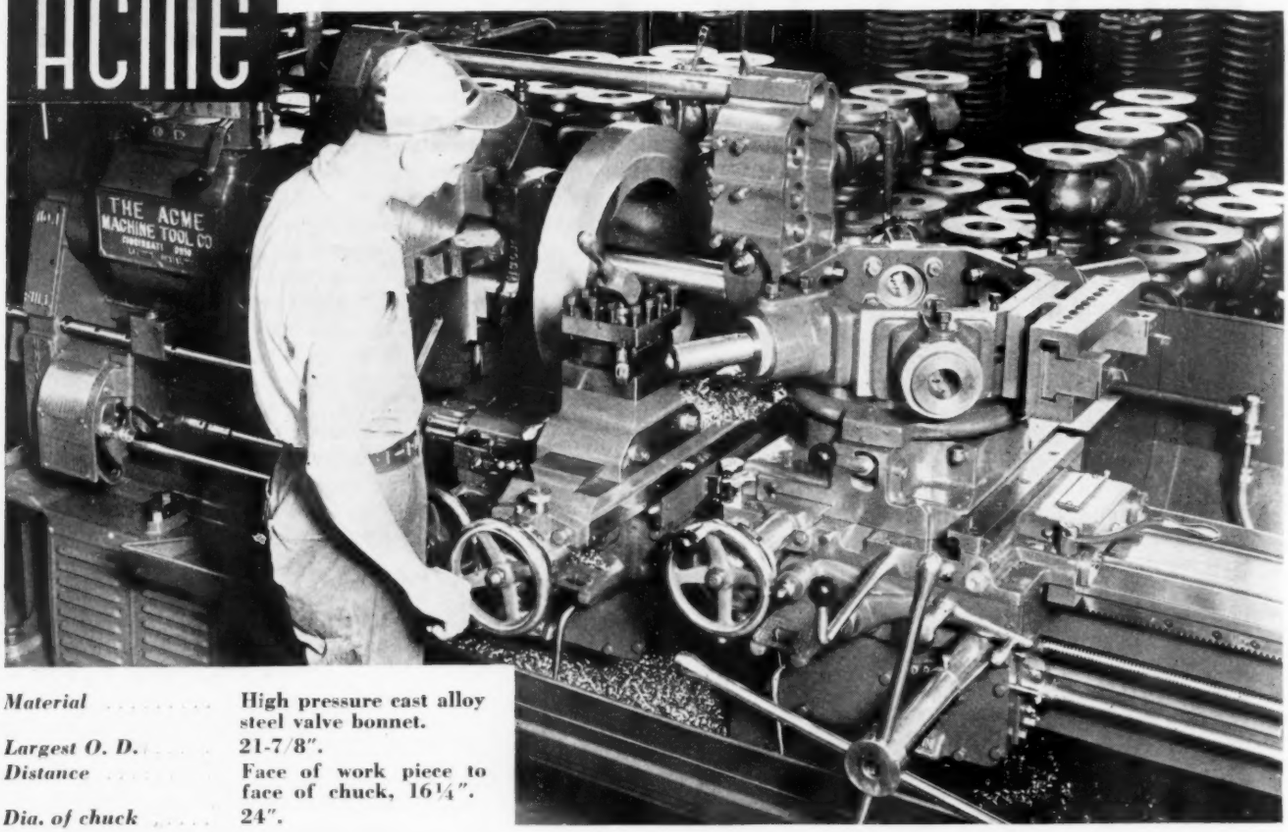
The Reference Book Sheets on pages 303 and 305 will prove a big help in equally spacing many holes in a circle. Concluding the set, the last sheet has coordinates for up to 54 holes—enough, think we, for anybody.

COMING

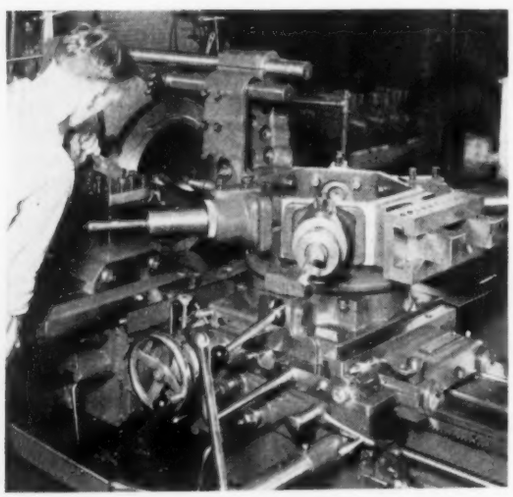
Manufacture of munitions in Canada under war-time conditions is a subject scheduled for analysis in our next issue. Made possible only through a long series of negotiations with the Canadian Ministry in Washington, the Canadian War Resources Board and the Canadian Board of Censors, it will reveal the technique being used to turn out 40-mm. shells and machine guns. Look for it in the May 15 AMERICAN MACHINIST.

Cincinnati ACME

1S-25" SWING UNIVERSAL TURRET LATHE



Material	High pressure cast alloy steel valve bonnet.
Largest O. D.	21-7/8".
Distance	Face of work piece to face of chuck, 16¼".
Dia. of chuck	24".



Material	High pressure cast alloy steel valve bonnet.
Largest O. D.	19½".
Distance	Face of work piece to face of face plate, 11½".
Dia. of face plate	24".

RIGIDITY in handling large diameter chucking work . . . SAVINGS effected in initial investment and operating costs

● A leading valve manufacturer takes advantage of the versatility of the No. 1-S, 25" CINCINNATI ACME Universal Turret Lathe and effects savings of 35% in manufacturing costs.

The captions under illustrations give important dimensions of work and distances which would ordinarily have to be handled on large heavy duty and more cumbersome machines. The No. 1-S, 25" Cincinnati Acme is easily handled, affords centralized controls—operator can stand up close to his work—all of which minimizes fatigue and increases production.

Swings: 27" over vees—25" over carriage wings—19" over cross slide.

Consult our tool engineers on how you, too, can effect savings.

THE ACME MACHINE TOOL CO., ... CINCINNATI, OHIO.

Welding in jig time

BY JOHN HAYDOCK, MANAGING EDITOR

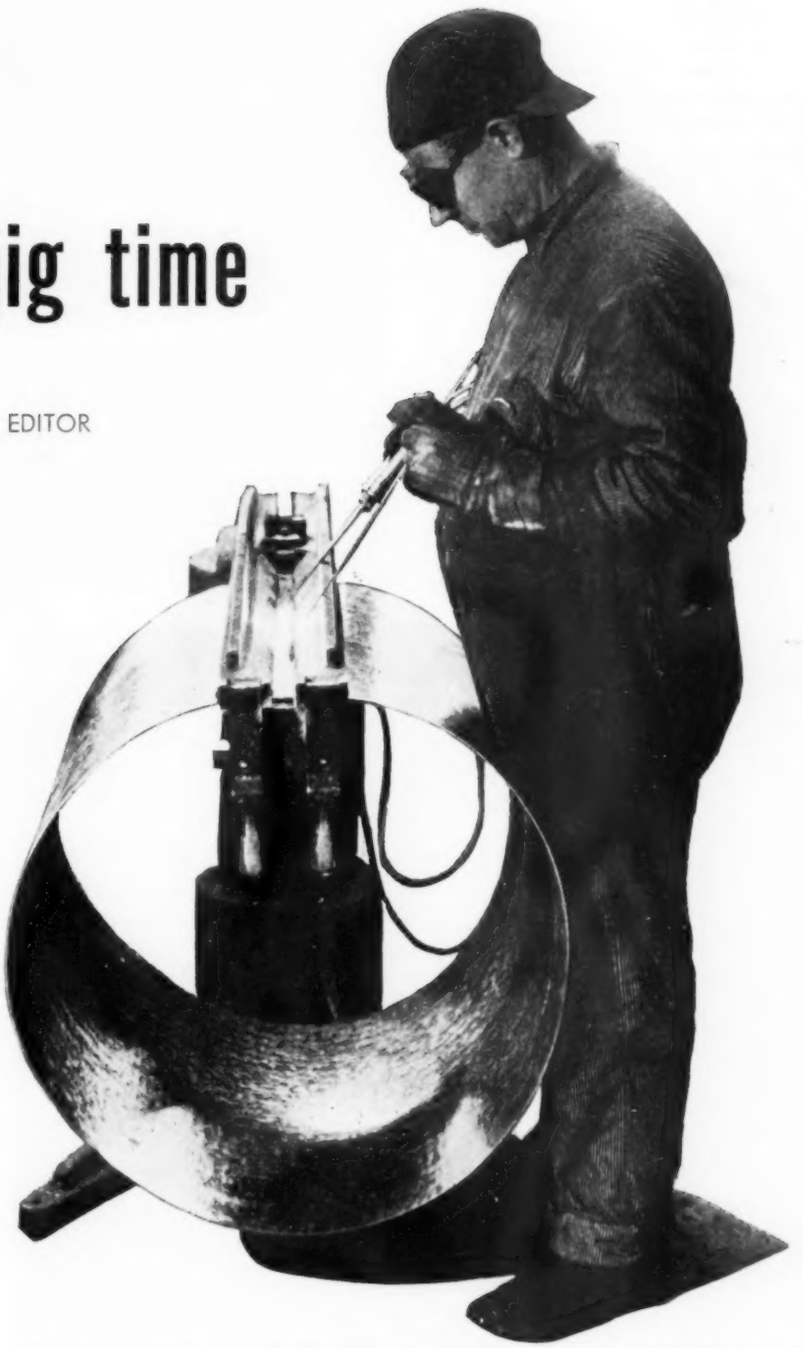
A well designed jig is worth its weight in welding rod. Planning in advance usually conserves time for the man at the torch

WHEN A WELDER comes up against a job that needs a jig of some kind, he is often able to make one himself. In jobbing work, particularly, he frequently takes his torch and a few pieces of scrap metal to rig up something that will serve his purpose.

This may not be engineering, but it saves the time that would have been necessary to get a jig designed in the engineering department. The jig may not look like much, when it is finished, but often it enables the welder to turn out a satisfactory job without bothering anybody else.

Sometimes this is an advantage, and sometimes it is not. If the welder is intelligent and understands the basic principles of jig design, he can usually do a pretty good job. On the other hand, where production quantities are involved, a well-engineered jig is often worth the additional time and trouble needed to lay it out on paper. This also holds true for general purpose jigs so designed that they can be used on a wide variety of short-run work.

Letting the operator improvise his own jigs may at first glance seem to be the easiest way to do it. It must be remembered, however, that when he



A jig of the type illustrated forms a conventional method of making butt welds in cylindrical parts. Two heavy bars pull the edges of the sheet into place. They are clamped parallel to the seam and an inch or so back of the joint. The weight of the bars helps eliminate bulges in the sheet and retards the movement caused by contraction without entirely preventing it. In addition to positioning the work, the bars serve to conduct the heat away from the weld. When conditions warrant the bars can be hollow and water-cooled. In other cases, copper inserts serve to remove the heat more rapidly

is making jigs his time is lost for productive work. He may spend a good deal of time looking around for suitable pieces of scrap and then fabricate something that does not work out as he expected.

The ultimate solution is to do the planning for the man at the torch. On production work especially, problems of welded fabrication should be anticipated with all necessary jigs drawn up and built before the job is started. Good planning of this kind will save time and money in the long run. This is not to say that the improvised jig should not be used in the job shop, when unforeseen difficulties arise.

What Is a Welding Jig?

A welding jig is a device designed to facilitate the process of welding and to improve the quality of the product by holding the work pieces in proper relationship, by positioning them to afford ready access to the welded sections, and by limiting the adverse effects of heating and cooling.

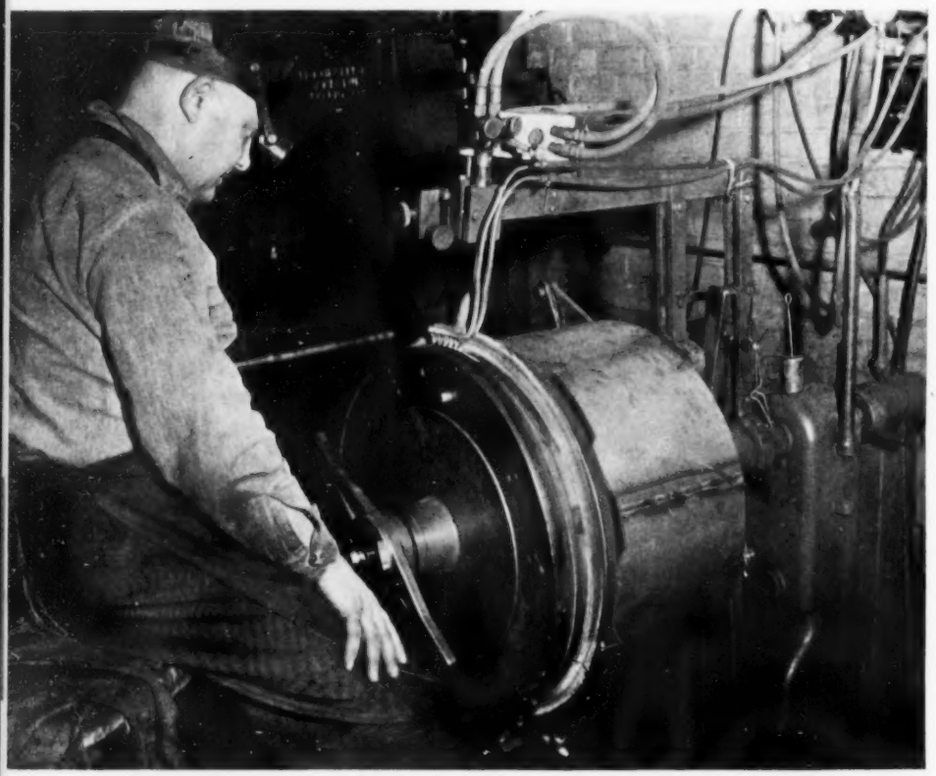
Welding jigs necessarily differ greatly from those used in the machine shop. One big difference is the change in temperature with its resultant expansion and contraction. Welded work is usually bulkier and very often flimsier than that found in the machine shop.

The basic requirements of a well-designed welding jig may be listed as follows:

1. SIMPLICITY. This is the basis of all good design. If a jig is simple it will be easy to make and easy to manipulate. In this field of work there is no excuse for complicated designs.

2. CONVENIENCE. The work must be held in position to make a good weld. Downhand welding is usually easier, but it is not always possible to get all surfaces in this position. Moving jigs are often used to bring various parts of the workpiece successively into handy reach of the operator. The motion of such jigs is supplied by hand in some cases and by power in others.

3. VISIBILITY. Besides getting at the work, the welder must be able to see it clearly, if he is to turn out a quality product. All jig designs must meet this requirement if the jig is to be of any practical use. Consequently, all gripping plates or brackets must be placed so they will not interfere with the operator's vision.



A jig used for washing machine tubs holds the work while the bottom of the tub is welded in place. In this case the work is mounted on a drum which is electrically driven through a gear-reduction unit. The torch is held on an over-hanging arm using several tips. The outer band of the jig, in addition to gripping the work, helps absorb the heat from the weld

4. RIGIDITY. Like all jigs, the welding jig must be strong enough to withstand deflection, or at least deflection beyond allowable limits. It should be remembered, however, that for thin gage metal, it is necessary to allow slippage of the stock rather than to hold it rigidly.

5. DURABILITY. Jigs designed for repetitive work must have wear surfaces that will stand up in usage. Where the jig is made for a single job or for a short run of work, this factor is naturally of less consequence.

6. HEAT CONTROL. A welding jig must be able to carry away the heat from the torch and in addition hold the work so that it will not buckle or overlap. It is well known that as the welded metal cools, contraction sets in. If a long seam is welded in light gage sheets, it is necessary to start the welds with the two edges at a slight angle. Then, as the weld progresses, the sheets will be brought together without overlapping. This contraction requires some motion in the sheets and it is necessary to provide for slippage in the clamping members. In some jigs, a spacing piece is used which is moved along as the weld progresses to keep the two edges the proper distance apart. In jig design it should always be remembered that the clamping surfaces act as chills which aid the workpiece itself in conducting heat away from the weld. Sometimes the jig is water cooled or provided with copper inserts to speed up this process. However, the chilling surfaces should not be so close to the weld that they will interfere with complete fusion.

7. PROTECTION OF WORK. On some work, particularly on aluminum and stainless steel sheets, it is important not to mar the surface. For this reason, jigs must be designed so that the clamping fingers will hold the work without scoring it. Soft pads of asbestos or other material are used to protect the work in some instances.

8. CLAMPING PRESSURES. This requirement is closely associated with heat control and protection of the work. A few welding engineers have gone so far as to figure deflection in the jig base and in the clamping fingers to produce excellent results. More often the clamping pressure is arrived at by a cut-and-try method, or on the basis of past experience. A good workable solution of this question has much to do with the success of the jig.

9. COST. The cost of welding jigs must be considered on the basis of

The purpose of a jig like this is to locate the various parts of a more complicated assembly while they are being welded together. This particular jig is used for connecting the evaporator with the gas heat exchanger and the absorber. Note the built-in brackets for holding welding rods. The cylindrical parts of the assembly are held in V-blocks by means of quick-acting toggle clamps

that of any piece of new equipment. An estimate should be made of the time saved per piece, the number of pieces to be made, and the possible future use of the jig. Balanced against this is the cost of the jig itself. Sometimes jigs are necessary in order to get the job done at all, or in order to hold it to specifications. Where the quality factor dictates the use of a jig, there is no alternative but to use one. When figuring on exacting jobs, the cost of welding jigs should be included along with production costs in arriving at the final estimate.

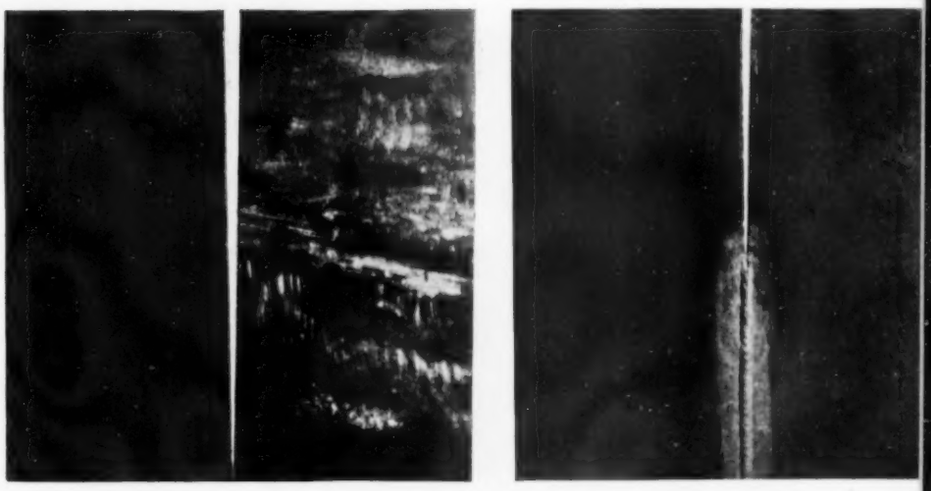
10. STORAGE FACILITIES. A shop using a lot of jigs must figure on storage space. Otherwise it will be crowded with bulky units, used only occasionally, causing considerable inconvenience. With a little ingenuity, a great many jigs can be designed so they can be dismantled into relatively flat units and put away without taking up much otherwise usable room.

Jigs may be roughly divided into three classes: stationary jigs, hand-operated jigs and power-operated jigs. The simplest jigs are usually made up of structural shapes, together with C-clamps. Such clamps are cheap to use because they can be employed over and over again on different jobs, but they are not quick-operating and consequently do not afford the best solution on production runs. Toggle clamps are quick-acting and when properly designed will exert close control of pressure. Spring clamps, wedges, H-clamps, knobs, straps and bolts are some of the other common means of holding work in place. Each type must be considered in connection with a particular job.

Hand-operated jigs range all the way from a simple mandrel, on which the work is revolved, to some extremely complicated devices. Some of the simpler types consist of the horn jigs for cylindrical work, turn-tables, trunnions, faceplates and spiders for holding the work internally.

Power Operated Jigs

Power, either electric or pneumatic, is frequently applied to the same kind of jig that is hand-operated in its simpler form. The application of power is always a question of judging between increased production and increased cost of the jig. Power may be applied merely to clamp the work in place and to release it after the welding has been completed; or it may be used to move the work, either intermittently or continuously, as the welding operation progresses. In such cases it greatly expedites the operation by giving an opportunity for almost continuous welding. Power clamping removes the human element in setting up a job and eliminates variations in clamping pressure.



These views show two sheets of metal in the process of being welded together. As welding progresses along a straight seam, the edges of the metal will first spread slightly because of expansion, and then draw together as the weld cools (as at the right). Unless this motion is controlled, the edges may overlap before the weld is completed. To allow for contraction, a wedge-shaped gap is left between the two sheets. This varies with the thickness of the sheet and with the length of the seam. A rule-of-thumb approximation is to allow spacing equal to the thickness of the sheet for every foot of weld length. The sheet movement is held to a minimum by welding as rapidly as good practice permits

Hydraulic drive shifts into high

BY R. W. WARNOCK, FACTORY MANAGER, DETROIT TRANSMISSION DIVISION, GENERAL MOTORS

An impossible job, outsiders remarked, when General Motors started to produce automatic transmissions. But the job has been licked. Here is the story

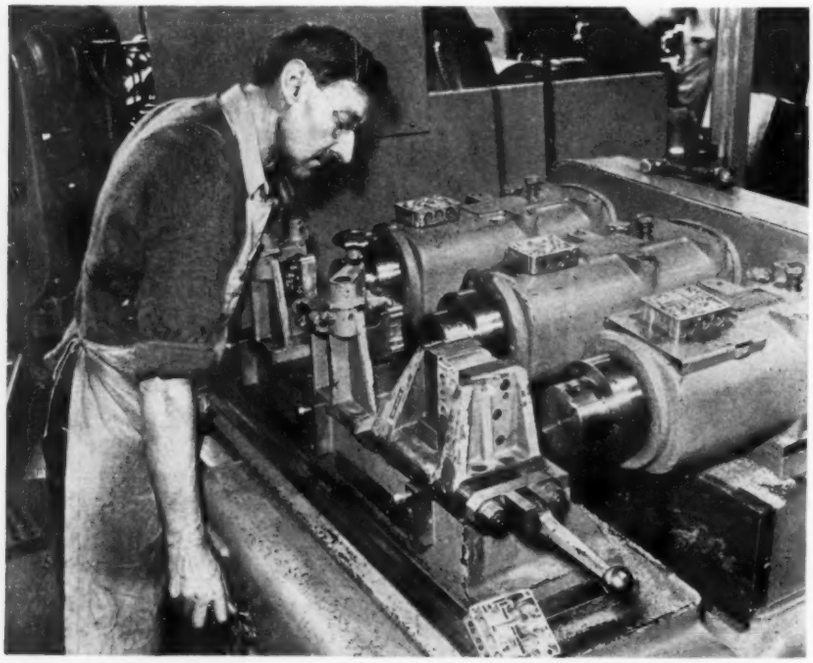
FOR MONTHS speculation has been rife in Detroit concerning the manufacture of the "Hydra-matic" drive offered as optional equipment in Oldsmobile sixes and eight. When tooling up began last year, it was recognized that this automatic transmission was more difficult to make than an earlier semi-automatic type. To outsiders, the precision standards involved appeared impossible to maintain in volume production. Yet here are the facts.

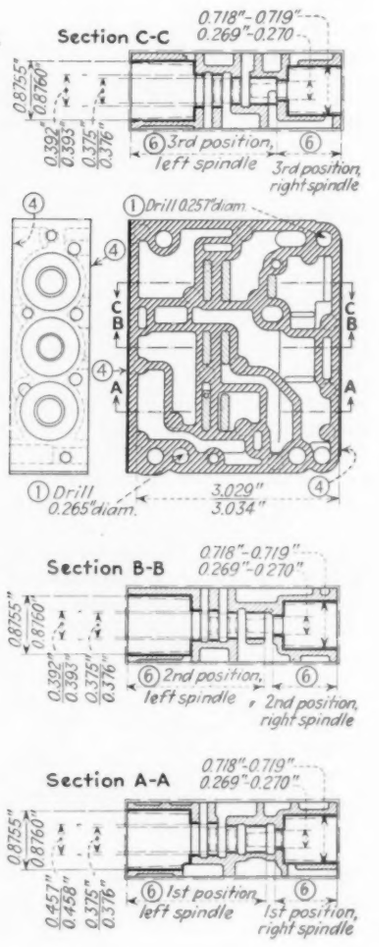
The first automatic transmissions were actually built in October last year. Exactly five months later the plant had produced a total of 7,000 units and was achieving a daily output of 225 units.

The drive consists essentially of a fluid coupling and an automatic transmission in which gears are shifted automatically according to car speed. For compactness and lower manufacturing cost, four die-cast valve bodies and a governor body are used. The latter, and the inner and outer valve bodies, incorporate a multiplicity of valves for actuating clutch and brake-band pistons. Many of the valve holes and main passages are interrupted by side passages and holes. Metal has been added wherever possible to avoid drill run-out and distortion from clamping in machine fixtures. This article deals with machining these die-cast parts.

Operations on Inner Valve Body

Several difficult problems are involved in machining the inner valve body, as follows: (1) face the top and bottom surfaces flat for an oil-tight metal-to-metal seal with mating members since no gaskets are used, (2) also face the two ends flat for an oil-tight seal, (3) precision bore three stepped-diameter holes at sections *A–A, B–B,* and *C–C*. The limit on all diameters is 0.001 in., which is not difficult to maintain, but these diameters must be concentric within 0.0005 in. total indicator reading.





Sections *A-A, B-B* and *C-C* show the interrupted nature of the holes in the inner valve body, which must be precision bored to an exceptionally close limit for concentricity, besides being truly round to pass a leakage test. The numbers refer to the text, denoting the operations involved. Precision facing of the valve bodies is done by using the appropriate number of spindles on a precision boring machine and suitable fixtures. The operator is facing the top of the inner body in the left-hand fixture. Next it is moved to the center fixture for facing the bottom, and then transferred to the right-hand fixture for facing one end. After the adjacent completed piece is removed, the stated piece is reversed in the third fixture for facing the other end; the following piece from the center fixture then takes its place. Cemented-carbide tools are now being used for these facing and boring operations

The inner valve body is shown in one of the drawings. The numbers on the drawing refer to those used in the following production sequence:

1. Ream two dowel-pin locating holes at diagonally opposite corners. Each reamer removes 0.0075 per side from the die-cast hole, the operation being carried out on a drill press. Holes are die-cast to ± 0.003 in. tolerance, which is not adequate for locating purposes.
2. Tap two No. 10-24 holes.
3. Drill a vent hole on a bench drill.
4. Precision face the top and the bottom and the two ends on a precision-type machine. The bottom surface and the two dowel-pin holes are used for all subsequent locations.
5. Drill and ream all except five holes on an eight-station indexing machine with sixteen fixtures. The work makes two circuits, being turned over at the end of the first cycle.
6. Precision bore all valve holes on a three-spindle, two-way precision boring machine. Piloted boring bars are not used because the holes are large. The three stepped-diameter valve holes at sections *A–A*, *B–B* and *C–C* are machined from both sides at the three positions. The boring sequence is:

First Position—Left-hand spindle bores the 0.8755 in., 0.457 in., and 0.375 in. holes at section *A–A*. The right-hand spindle bores the 0.718 in. and 0.269 in. holes.

Second Position — Left-hand spindle bores the 0.8755 in., 0.392 in. and 0.375 in. holes at section *B–B*. Right-hand spindle bores the 0.718 in. and 0.269 in. holes.

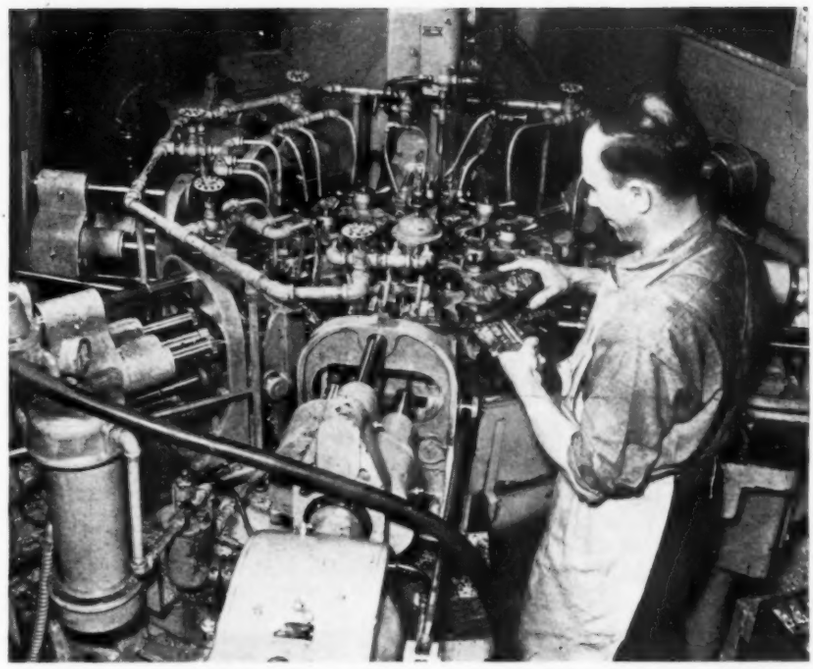
Third Position—The left-hand spindle bores the 0.8755 in., 0.392 in. and 0.375 in. holes at Section *C–C*. Right-hand spindle bores the 0.718 in. and 0.269 in. holes.

7. Burr all holes and slots by hand.
8. Wire brush the top and bottom faces.
9. Hand lap the top and bottom faces and the two ends.
10. Wash and inspect.

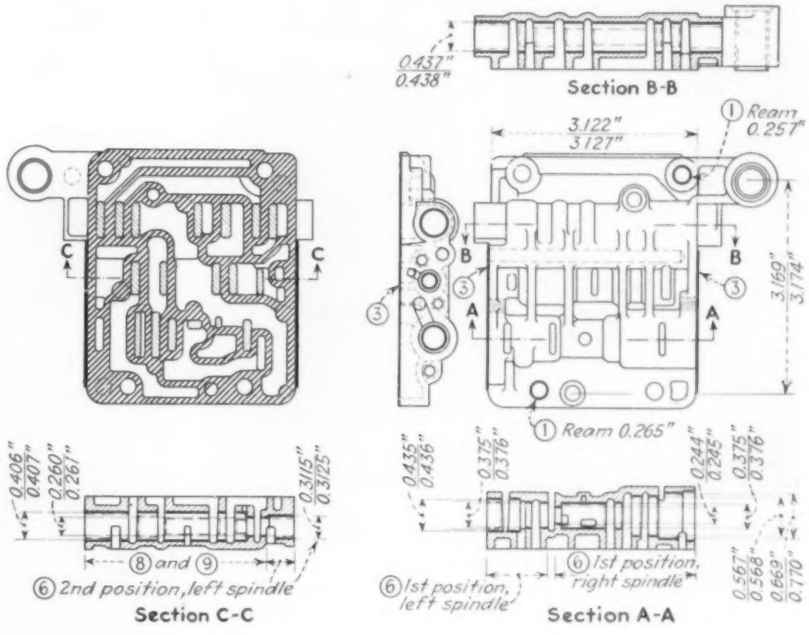
Operations on Outer Valve Body

Machining operations on the outer valve body are much the same as those on the inner valve body, but the valve holes are smaller; therefore, piloted boring bars are necessary to maintain size, roundness and concentricity despite interrupted cuts. The numbers on the drawing refer to those in the following production sequence:

1. Ream two locating dowel-pin holes on a drill press.



Four diameters at section *A-A* of the outer valve body must be bored to a total limit for concentricity of 0.0005 in. Piloted boring bars are used for boring the holes at sections *B-B* and *C-C;* for this reason, the valve hole in section *C-C* must be bored in two set-ups. Drilling and reaming the outer valve body are done with duplex fixtures on an eight-station indexing machine. The fixtures permit the outer body to be reversed after one circuit so that the holes can be completed from the opposite side. One outer body is completed in one circuit through the machine



2. Drill two vent holes.
3. Face the two sides and the bottom on a precision-type machine, using two of the three spindles, the bottom face and the two dowel-pin holes are used for locating purposes in all subsequent operations.
4. Drill, tap and ream all holes except four on an eight-station indexing machine with sixteen fixtures. The work is turned over for the second cycle through the machine. The valve holes are roughed and semi-finished on this machine with step reamers, leaving 0.005 in. per side to be removed in precision boring.
5. Drill two holes in a bench drill.
6. Precision bore both ends of one

valve hole at section *A–A* and one end of another valve hole at section *C–C* on a two-way two-spindle precision boring machine, as follows:

First Position—Left-hand spindle bores the 0.435 and 0.375 in. holes. Right-hand spindle bores the 0.669 in., 0.567 in., 0.375 in., and 0.244-in. holes.

Second Position—Left-hand spindle bores the 0.3115-in. hole. The right-hand spindle is idle. Piloted boring bars with cemented-carbide tools are used.

7. The straight-through 0.437 hole at section *B–B* is precision bored on a single-way two-spindle precision boring machine, two pieces being done at once. Boring bars are piloted at both ends of the hole. After the work is slipped over the free end of the boring bar and located with dowel pins, a leaf containing outboard bushings is swung up into place and locked before boring commences.

8. At section *C–C* again, the 0.406 and the 0.260 in. holes are precision bored two at a time on a two-spindle single-way boring machine.

In operations 6, 7 and 8, each boring bar must produce groups of holes that are concentric with one another to a total limit of 0.0005 in. It is necessary, however, that the holes produced by opposed boring bars be concentric within this limit because two opposed valves are used in cases where boring must be done from both sides of the hole.

9. Finish reaming is required for the valve hole bored in operation 8, in order to remove fuzz at the sharp edges at the interruptions in the hole. It is done on a bench drill.

10. Burr holes and slots by hand.

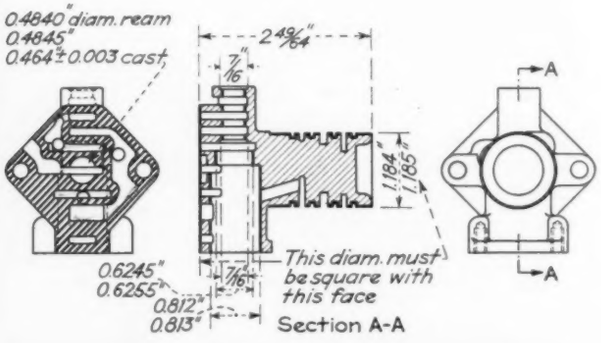
11. Wire brush burrs from bottom face.

12. Lap the bottom face and the two ends on a cast-iron plate.

Operations on Governor Body

All holes in the die-cast governor body are rough bored, drilled, reamed and tapped, as required, in a six-station indexing machine with two positions for each fixture. In a second set-up, using a single-way three-spindle boring, facing and turning machine, four operations are performed: turning the outside diameter of the hub, boring the main hole, facing the flange, and grooving the hub for small piston rings. Interrupted cuts for all four operations are necessary because of the intricate nature of the governor body.

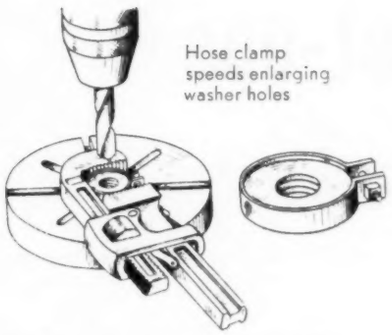
The die-cast governor body is rough bored, drilled, reamed and tapped on this six-station indexing machine with two positions in each fixture. The operator is placing the piece vertically in one position on the fixture, while at the right another piece can be observed clamped horizontally in the second position



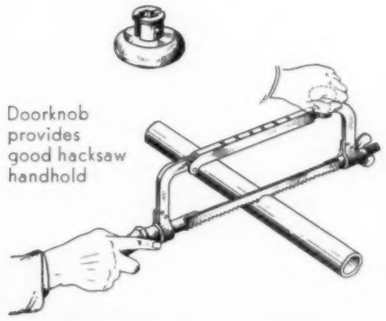
Four operations are performed on the die-cast governor body. They are done in two automatically controlled phases. First phase—the carriage moves in so that a single-point tool on the cross-slide turns the outside diameter of the hub of the piece held in the spindle fixture, which is nearest the operator; the boring bar in the second spindle precision bores three diameters. Second phase—the carriage moves away, the slide feeds to the rear, the carriage moves toward the headstock, and the slide feeds toward the front so that the third spindle faces the flange on a piece held in the rear fixture; a tool in the front block grooves the piece in the front spindle

SHORT CUTS FOR THE SMALL SHOP

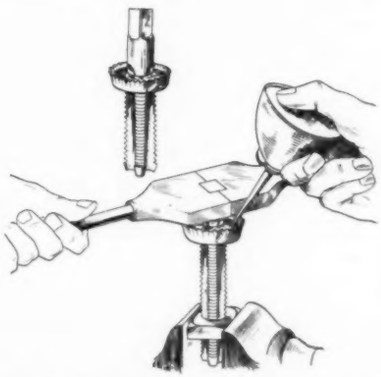
BY A. H. WAYCHOFF



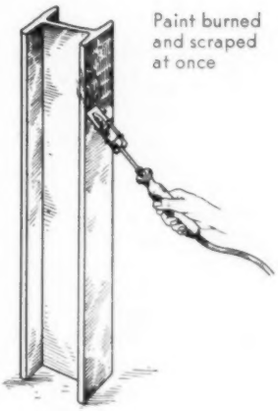
DRILLING WASHERS to make the holes a little larger nearly always takes more time than the job seems to be worth. One machinist made it a lot easier by stacking five or six washers and clamping them together with an ordinary automobile radiator hose clamp. Then he laid them on the drill press table and held them from turning with a monkey wrench.



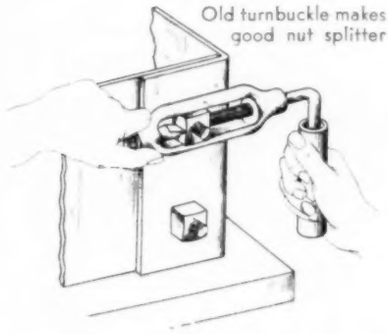
A HANDY HACKSAW ATTACHMENT is shown in the sketch. An old doorknob is slotted through the shank with about three blades in the saw, so that the slot is at right angles to the setscrew hole. The doorknob can then be placed anywhere convenient on the hacksaw frame and held there by tightening the screw.



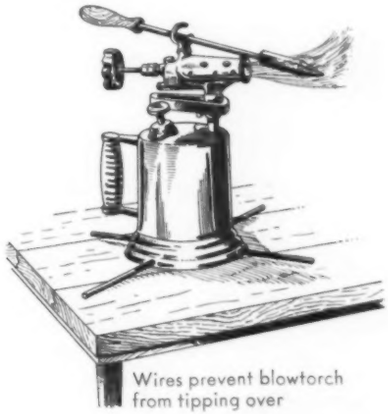
IN TAPPING HOLES the tap might just as well run dry for all the good most oiling methods do. But with these pop bottle caps a steady oil supply is fed to the tap all the time. Just a few, with a different size hole in the bottom of each, are enough. In use, one with about the right size hole is slipped over the tap, resting on top of the threads, with a little pledget of waste in it to hold the oil.



THIS COMBINATION paint burner and scraper will do good work on lots of small jobs. Just wire an old putty knife tightly to the side of an electric soldering iron. The tip of the iron should have one flat side, drawn firmly against the blade as near the edge as possible. That way the heat from the iron will keep the scraper hot and make it easy to remove paint, putty and other coatings hard to scape off when cold.



SHEET METAL WORKERS especially will find this little nut splitter one of the handiest ever. For dismantling parts put together with nuts and bolts it does the job quickly, easily, and with no danger of tearing the holes in the metal. It's made from an ordinary turnbuckle, with one rod saved and bent down for a hand hold. In the other end is screwed a little chisel ground from a scrap of drill rod. To use the gadget, just slip it over the nut and tighten the screw. Only a little turning is necessary to split the nut so it can be unscrewed without damaging the bolt. Using this device is much better than trying to chisel the bolts off, ruining both the bolt and the nut and often tearing the hole in the work.



WHEN HEATING SOLDERING IRONS or melting lead with a blow torch, the weight often makes the torch topheady and tips it over, wasting time and causing danger of fire. A simple way of getting better footing for the torch is to drill four small holes through the apron base. Then when it's necessary to lay some heavy object on the burner, a couple of rods can be run through the holes to prevent the torch from tipping.

SCRAP SOLDER is generally a dead loss, but it can be reclaimed with no trouble at all by casting it into handy little sticks. An ordinary sheet of corrugated cardboard, fastened to the workbench and with a couple of wood strips tacked at the ends, makes a fine mold. Just pour in the molten solder, and when it cools you'll have a bunch of convenient sticks instead of a can of waste solder.

Typical bar stock set-ups

BY J. R. LONGSTREET AND W. K. BAILEY, THE WARNER & SWASEY COMPANY

Universal bar tools for turret lathes can be used for many different parts without making major set-up rearrangements

PERMANENT SET-UPS of universal tooling equipment arranged for bar work on a turret lathe can handle a great variety of jobs. This can be illustrated to advantage by examples of typical work to be found in many "average" shops.

The problem of machining bar work so that two or more diameters will be concentric is met both on one-chucking jobs and on work finished in two or more chuckings of the stock. The heat-treated alloy steel shaft in Fig. 45 is a typical piece which indicates how this problem may be solved.

From a forthcoming book on turret lathe tooling.

Diameters (6), (7), (9) and (10) are to be ground. They must be turned to within ±0.003 in. before grinding, and the four diameters must be closely concentric.

Since the total length of the piece is almost 24 in., a saddle-type machine will be used. Universal bar equipment will provide the necessary tools for all of the operations, with the exception of the thread. The problem will be to turn diameters (6), (7) and (9) concentric in the first chucking, and then to turn diameter (10) concentric with diameter (9) in the second chucking. In making the set-up, the threads on the end of the shaft, at (3), are cut with a die head but, because of the close limits, the 1½ in., 12-pitch threaded section at (5) will be thread-milled after the grinding operation. The suggested set-up for the first chucking is shown in Fig. 46.

One method of making certain that diameters (6) and (7) will be

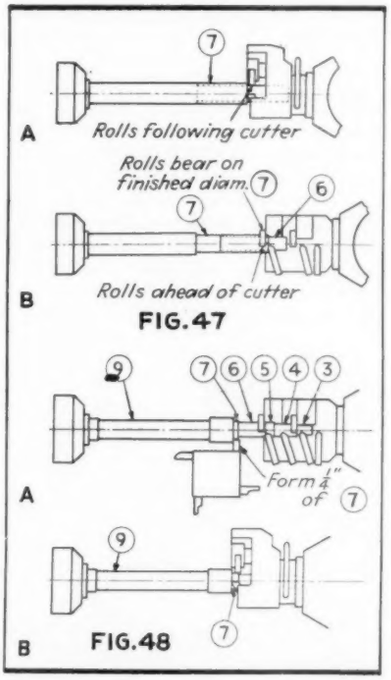


Fig. 47—These settings of single and multiple cutter turners will center diameters (6) and (7)

Fig. 48—A shorter total turning length is secured by turning diameters (6) (7) in these steps instead of those in Fig. 47

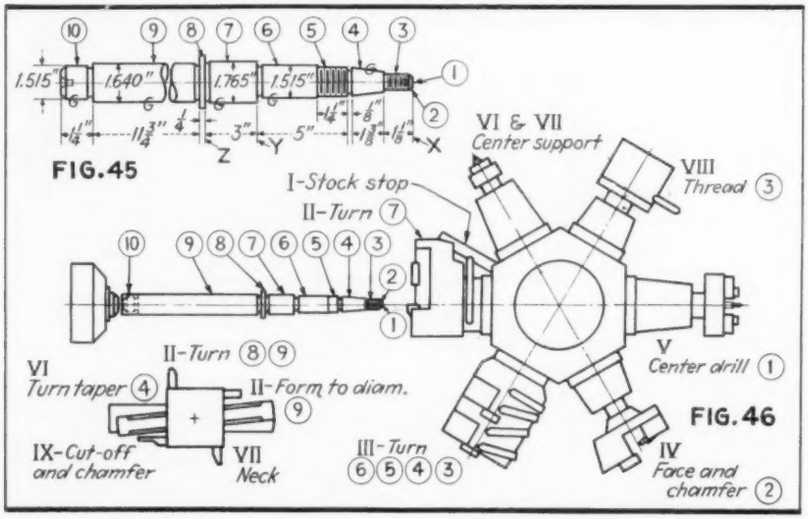


Fig. 45—Diameters (6), (7), (9) and (10) must be closely concentric on this alloy steel shaft. They are turned within ±0.003 in. before grinding. Fig. 46—This set-up for first-chucking operations on the shaft in Fig. 45 uses universal bar tooling

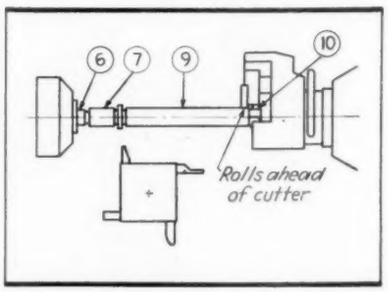


Fig. 49—Second chucking of shaft in Fig. 45 finishes diameter (10) with rolls of the single-cutter turner bearing on diameter (9)

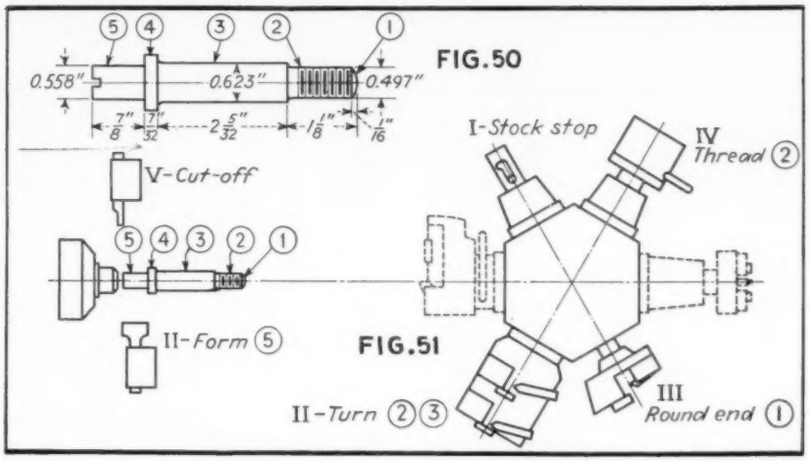


Fig. 50 — A ram-type turret lathe having a screw-feed cross slide is used to make this shoulder stud from bar stock. Fig. 51—Only four stations on the hexagon turret are required for this set-up. Forming and cut-off cuts are taken with the cross slide

concentric is to first turn diameter (7) with a single cutter turner, with rolls following the cutter, starting at the end of the piece as at *A* in Fig. 47. Then, with the rolls leading the cutter and bearing on diameter (7), turn diameter (6) with a multiple cutter turner, as shown at *B* in the same illustration. Diameter (6) will then be concentric with diameter (7).

Another, and quicker, method when the diameters are long is shown at *A* and *B* in Fig. 48. Here, diameter (6) first is turned with the multiple cutter turner, with rolls following the cutter, and then while supporting the end of the piece against the rolls of the multiple cutter turner, form about $\frac{1}{4}$ in. of diameter (7) with a cutter in the square turret. Diameter (7) next is turned with the single cutter turner, using this formed diameter to give the rolls of the turner a true start.

In the first method, Fig. 47, you have to turn the length *X* to *Z* (Fig. 45) and then *X* to *Y*, which is a total of $18\frac{1}{4}$ in. By the second method, length *X* to *Y* is turned and then, after forming $\frac{1}{4}$ in. of diameter (7) the length from *Y* to *Z* is turned, for a total turning length of $10\frac{5}{8}$ in. In both cases the multiple cutter turner would be used for turning diameter (6), and cutters also would be set in this turner for diameters (3) and (4), which are turned at the same time.

To produce diameter (9) concentric with diameters (6) and (7), it should be finished turned in the same chucking. Part of this operation can be performed while diameters (6) and (7) are being turned. Diameter (9) should be turned while the bar is supported against the rolls of one of the roll turners. The same cutter used to form the $\frac{1}{4}$ in. length of diameter (7) is used to form a short portion of diameter (9), which then is turned with a cutter held in the square turret.

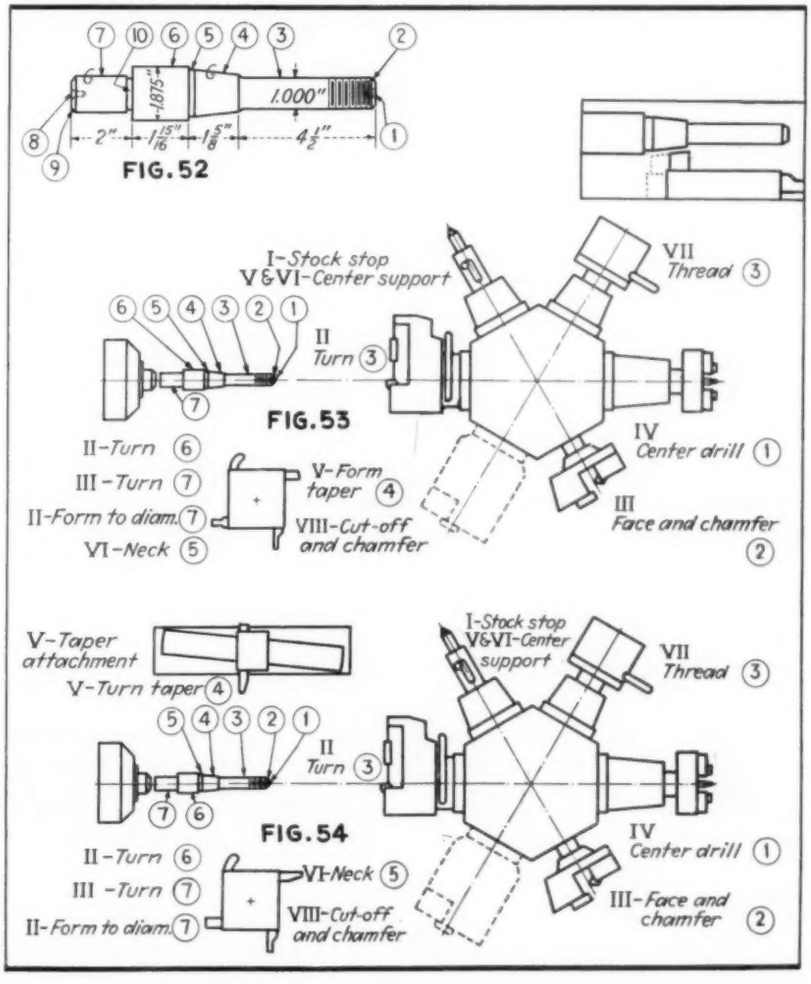
In the second chucking of this shaft, Fig. 49, diameter (10) is produced concentric with diameters (6), (7) and (9) by turning it with the rolls of the single cutter turner leading the cutter and bearing on diameter (9), which was made concentric with diameters (6) and (7) in the first chucking.

The following layouts illustrate how a wide variety of bar jobs can be handled economically with universal bar equipment. The first of these, Fig. 50, requires almost exactly the same type of tools as were used on the shaft job just analyzed. This shoulder stud is a typical bar job for a small ram-type turret lathe equipped with a screw-feed cross slide. The tooling layout for this part, Fig. 51, uses this cross slide for only two operations.

Diameter (5), which must be held to a 0.001 in. tolerance, is formed with a cutter on the front of the cross slide, while diameters (2) and (3) are turned from the hexagon turret with cutters held in the multiple cutter turner. Following this the radius on the end is machined with a cutter held in a combination end facer and turner, the thread is chased with a die head, and the piece is cut off.

The taper stud shown in Fig. 52

Fig. 52—Cross-slide and hexagon-turret cuts can be combined to advantage when turning this stud. Fig. 53—Small-lot quantities call for this type of tooling layout. Taper is formed with a wide cutter ground to the proper angle. Fig. 54—A cross slide taper attachment turns tapers in this set-up for medium-size lots



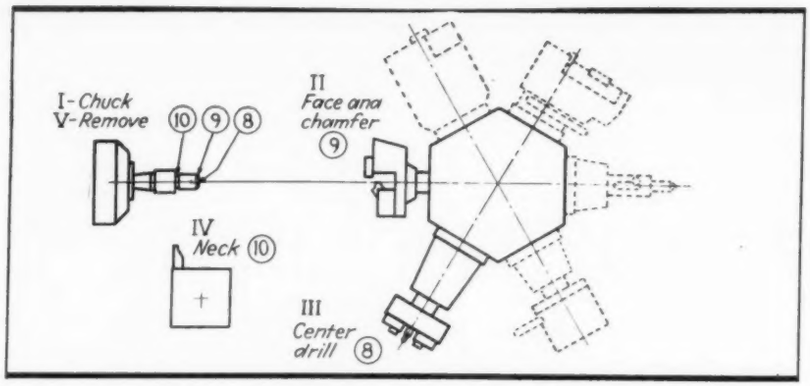


Fig. 55—The taper stud shown in Fig. 52 requires a second chucking for facing, chamfering, center drilling and necking operations

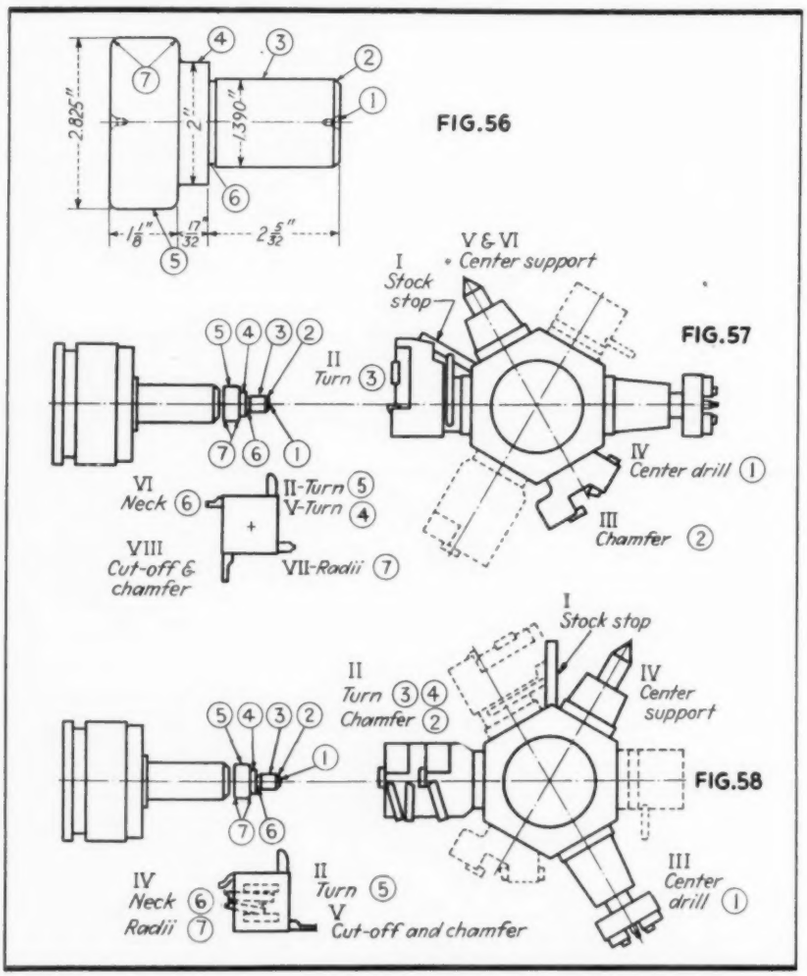


Fig. 56—This stud gear should be set up in a saddle-type machine. Fig. 57—Small-lot production layout combines turning of diameters (5) and (3). Fig. 58—All turning operations are done at once in the quantity-production layout for the gear in Fig. 56

does not offer much opportunity for taking multiple cuts, but there is a good chance to combine cuts from the cross slide with cuts being taken by the hexagon turret. Tooling layout shown in Fig. 53 is designed for small lot production; that shown in Fig. 54 would be suitable for medium-lot quantities.

In both small and medium lot production the turning of diameter (6) and the forming of diameter (7) can be combined with the turning of diameter (3). Also, the facing and chamfering of the end (2) can be combined with the turning of diameter (7).

For small lot production the taper would be formed with a standard wide cutter, ground to the proper angle, and the cut matched (see inset in Fig. 53). These matched cuts will not be very accurate, but as the taper will be ground in a later operation the job will be satisfactory if sufficient stock is left for grinding. If a form tool wide enough to cut the taper in one pass is available it should, of course, be used.

A cross-slide taper attachment may be set up and used for single point turning of the taper for medium-lot production. It will probably take as long to turn the taper by this method as to form it as in the layout of Fig. 53, but the taper turned in the layout shown in Fig. 54 will be more accurate. Less stock must be left for grinding when this method is used, hence the grinding operation will require a shorter time.

The layout in Fig. 55 shows the simple set-up required for the second operation on this taper stud. This set-up would be the same whether made for a small or a medium size quantity. The part is chucked by diameter (3) and diameter (9) is faced and chamfered with a single cutter turner on the hexagon turret. Next, the piece is centered (8) from the hexagon turret while the cross slide is used for the necking operation (10) between diameters (6) and (7).

Stud gears, like the one shown in Fig. 56, will be produced on a saddle-type machine because of the diameter of the stock and the heavy cut required. The small-lot production layout for this part, shown in Fig. 57, indicates that the turning of diameter (5) can be combined with the turning of diameter (3), but in this layout there is no possibility of taking multiple cuts from the turret.

Sequence of operation, using this layout, would be: I—Feed stock to stop; II—turn diameter (5) with cutter in square turret while turning diameter (3) with a single cutter turner on the hexagon turret; III—chamfer the end (2) with facing tool on hexagon turret; IV—center drill (1) from hexagon turret; V—support end of shaft with center on hexagon turret while turning diameter (4) with cutter in square turret; VI—neck diameter (6) while end of bar is supported on center; VII—machine radii (7) with cutter in square turret; and VIII—cut off piece and chamfer end of bar. It should be noted that the combined turning of

diameter (5) with diameter (3) is made possible by locating the end of the bar far enough from the collet chuck so that the tools in the square turret do not interfere with the chuck.

The quantity production layout for this gear (Fig. 58) shows that all of the turning can be taken at one time by using a multiple cutter turner on the hexagon turret and one cutter in the square turret. The radii (7), which on the small lot set-up were taken separately, can be combined, and at the same time diameter (6) can be necked. Although in this layout three of the six turret stations are idle, it will not pay to remove the heavy tools unless a very large quantity is to be made.

Tools for Adjusting Screw

Tooling layouts for the first chucking on the adjusting screw shown in Fig. 59 will vary a great deal, depending upon the quantity to be produced. Figs. 60, 61 and 62 show suggested set-ups for small lot, large lot and high quantity production requirements.

In the small lot layout, Fig. 60, only diameter (6), the longest cut from the end of the bar, is turned from the hexagon turret. After this cut is started, diameter (7) is formed and the turning cut (8) is started. This is a good example of how combined cuts can be taken, even on small quantity production.

After diameters (6), (7) and (8) have been finished, the end of the shaft is faced and chamfered, and then centered from the hexagon turret. Next, with a center mounted on the hexagon turret to support the end of the shaft, diameters (3), (4) and (5) are turned and diameters (9), (10) and (11) are necked. The remaining operations of threading and cutting off are performed in the usual manner.

The layout for large lot production, Fig. 61, is so arranged that all diameters except (7) and (8) are turned from the hexagon turret. Diameters (6), (7) and (8) are combined as in Fig. 60. Diameter (3) is turned by the combination end facer and turner, and diameters (4) and (5) and the facing and chamfering of the end of the shaft (2), are taken with the multiple cutter turner. Necking operations are the same as in Fig. 60.

All of the turning cuts are taken at the same time in the quantity production set-up, Fig. 62. While diameters (3), (4), (5) and (6) are turned the end of the shaft (2) is faced and chamfered with cutters in the multiple cutter turner. Diameters (7) and (8) are machined with cutters held in the square turret. Following this, the end of the shaft is centered then, with the shaft supported by a center in the hexagon turret, diameters (9), (10) and (11) are necked at the same time with cutters held in a standard necking tool block mounted on the rear of the cross slide.

While this set-up is for high-production quantities, the tooling all is based on standard equipment, although a special cutter block is required for the multiple cutter turner. The cost of this special block easily can be justified by the savings made when producing large quantities.

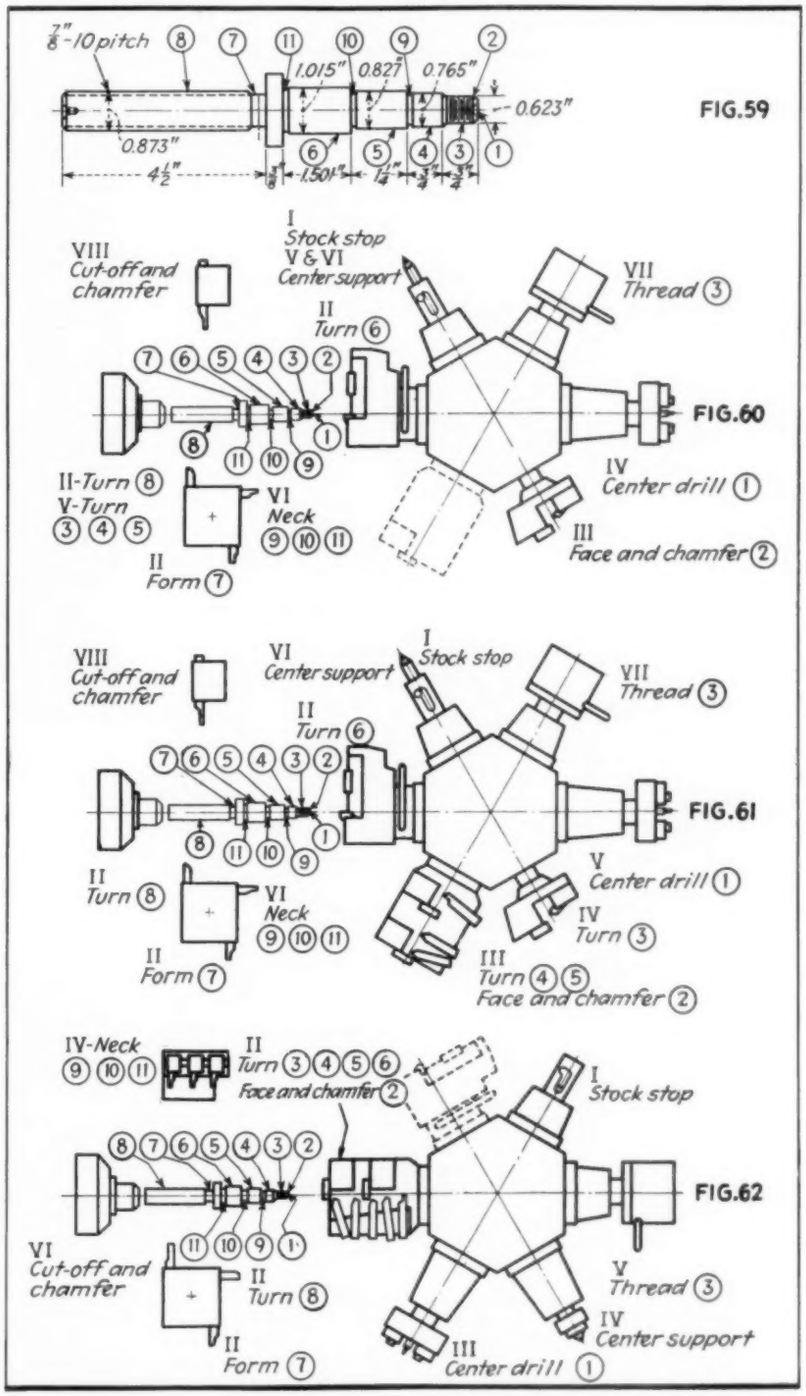


Fig. 59—Quantity to be produced will govern the tooling set-up best adapted for this adjusting screw. Fig. 60—Hexagon turret is used only for diameter (6) in this small-lot layout. Fig. 61—The layout for large lots is arranged so that all diameters except (7) and (8) are turned from the hexagon turret. Fig. 62—All turning cuts are taken at the same time in this layout for large production quantities

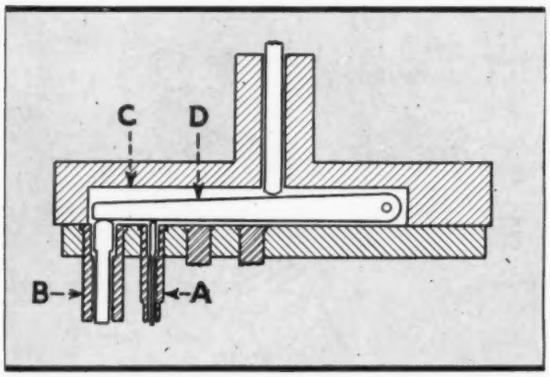
IDEAS FROM PRACTICAL MEN

Close-Quarter Knockout for Progressive Dies

By JOSEF N. PETERSON

Recently I had to build a set of progressive press tools having eight stations in which it was necessary to provide the last two stations with knockouts. Ordinarily the piercing die *A* at the seventh station and the final cut-out die *B* at the last station would have been located in the die-block, but for constructional reasons they had to be placed in the punch plate. That, of course, complicated matters somewhat, since the positions where the knockouts were needed were several inches from the center of the ram, but still not far enough for a couple of push rods to be put on the outside of the ram. However, the arrangement illustrated worked very well and is still in use.

A slot *C*, $\frac{1}{4}$ in. wide and about 1 in. deep was milled in the punch holder and housed the lever *D* which was pivoted at the inner end and operated by the press



A lever pivoted in a slot in the punch holder operates shouldered knockout pins at two stations in the die as the rain nears the top of its stroke

knockout, the outer end operating shouldered knockout pins in the dies.

In cases where the slot would interfere with the backing of any of the punches at the other stations, an intervening plate having holes for the knockout pins in the dies could be placed between the punch holder and the punch plate, but, of course, the knockout pins in the dies would have to be longer.

Safe Aids for Handling Lathe Chucks

By J. R. LONGSTREET AND W. K. BAILEY
Warner & Swasey Company

In order to prevent any damage to the machine or to the chuck, a board should be placed across the lathe bed ways so that the chuck can be rested on the board.

Heavy chucks not equipped with a tapped hole for an eyebolt can be lifted into position safely with this convenient and simple leather-belt rig

Chucks that are too heavy to be lifted easily by hand should be handled by a hoist. Most large chucks are provided with a tapped hole into which an eyebolt can be placed. If the chuck is not equipped for an eyebolt, a leather belt rig is recommended. A convenient rig, which has the advantage of gripping the chuck tightly, and is simple to make and use, is shown in the illustration.

When mounting a chuck to a spindle, always be sure that the spindle nose and the inside of the chuck are scrupulously clean. Then apply a thin coating of red lead and machine oil which will prevent sticking of the chuck to the spindle, even though it is left on the machine for a long time. When starting small chucks onto a threaded spindle, lock the spindle or throw it into low gear and turn the chuck by hand. With heavier chucks that require a hoist, the chuck may be started on the spindle thread by slowly revolving the spindle. Although chucks must be screwed tightly against the shoulder, they should not be spun so that they come up against the shoulder with a jolt. That would jam the chuck on the threads, making it difficult to remove it later.

When threaded spindles are run at high speed there is danger of the chuck unscrewing from the spindle

when the machine is stopped suddenly or reversed. To prevent this, locking shoes should be installed so that the chuck is locked to the spindle. The danger of having the chuck come off the spindle is greatest on high-speed machines, but the safest procedure is to provide locking shoes for all chucks mounted on all types of threaded spindles.

Accurate Contour Boring With An Indicator

By GEORGE WILSON

Contour boring, especially if the hole is comparatively small, is a fussy and ticklish job. The accompanying sketch shows how such a job can be accurately done by the use of a templet and a dial indicator.

Referring to the sketch, the templet *A* is clamped to the tailstock spindle by the parallel clamps *B*. The indicator is held to the toolpost by the usual rods, the rods being clamped thereto by any suitable clamp such as the regular adjustable type at *C*. The indicator spindle is set in contact with the templet at the starting point and the boring tool *D* is set to the starting point of the cut. As the carriage travels and the tool is fed in or out by the cross-slide to follow the contour of the templet, the indicator spindle is kept in contact with the templet by its spring. With a slow speed and a fine feed it is possible to keep the indicator pointer within one of the "thousandth" graduations on the dial.

At the end of the cut the carriage is run back to the starting point, care being taken to have the indicator clear the templet. As the tool is fed out for the next cut, the position of the indicator pointer on the dial will change, but since there is enough movement to the spindle (about $\frac{3}{8}$ in.) resetting the indicator is not necessary. To save time, the hole should first be roughed out, or drilled to approximately its smallest finished diameter.

An Indexing Head that Speeds Milling Jobs

By CHARLES R. STRYKER

The small indexing head illustrated is very convenient for laying out, drilling and doing certain jobs in a milling machine not equipped with a dividing head. The complete head is shown in Fig. 1, while the details of construction are given in Fig. 2. The body *A* is bored to receive the various parts and is machined on the bottom and one side so that it can be used in either the vertical or horizontal position.

The spindle *B* is tapered externally and is ground and then lapped in the taper hole in the body so as to turn freely without play. It is bored and ground internally to receive the shank *C* of the chuck plate *D*

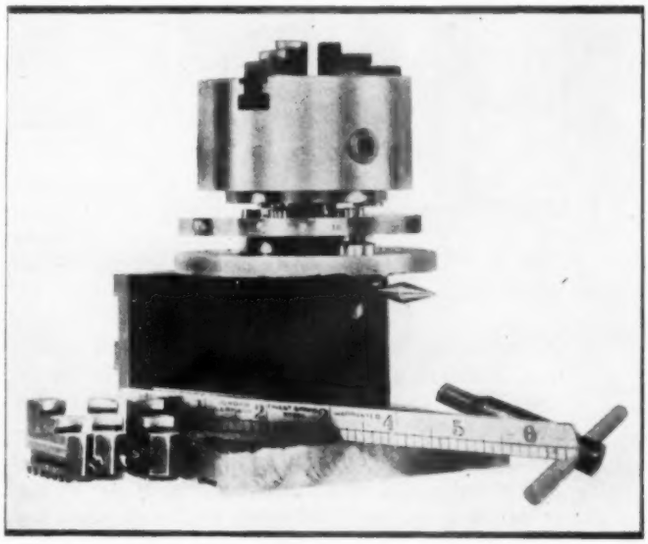
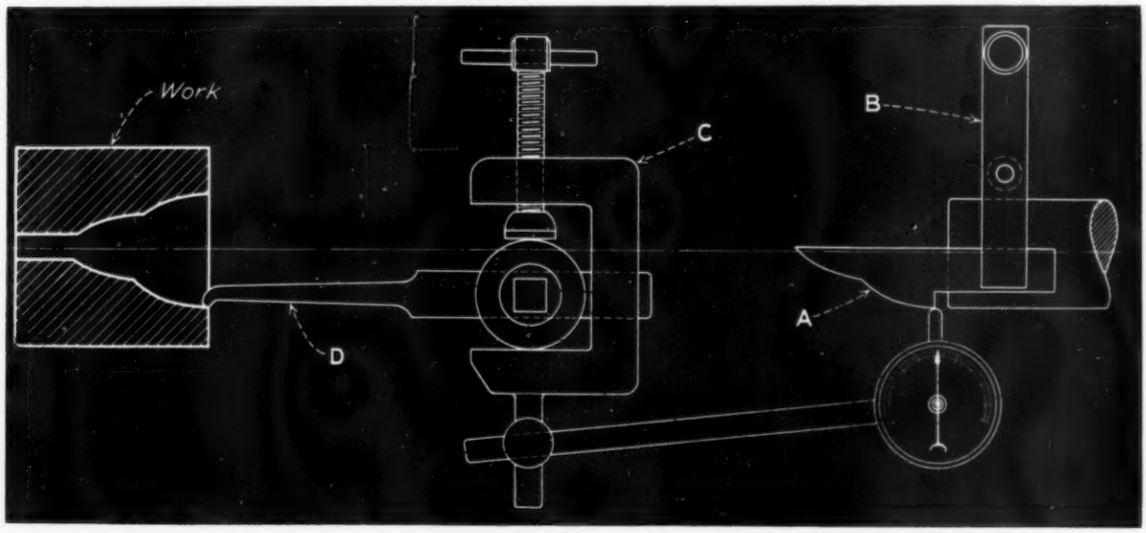


Fig. 1—The index head fully assembled. The bottom and one side are machined at right angles so that it can be used vertically or horizontally



The indicator spindle is kept in contact with the templet as the carriage travels and the pointer is kept at zero as the tool is fed in or out by the cross-slide

and is held in place by the collar *F* on its threaded lower end, downward thrust being taken by the shoulder *H*. On the upper end of the spindle is screwed and doweled the index plate *I* which has 24 holes and its edge is stamped with numbers indicating the location of the holes. The index pin is operated by the handle *K*, the shank of which is guided in the helical slot *L*. When the handle is pushed to the right, its shank travels up the helical slot and the index pin enters the hole in the index plate that is in line with it and is held by the spring *M*. When the handle is

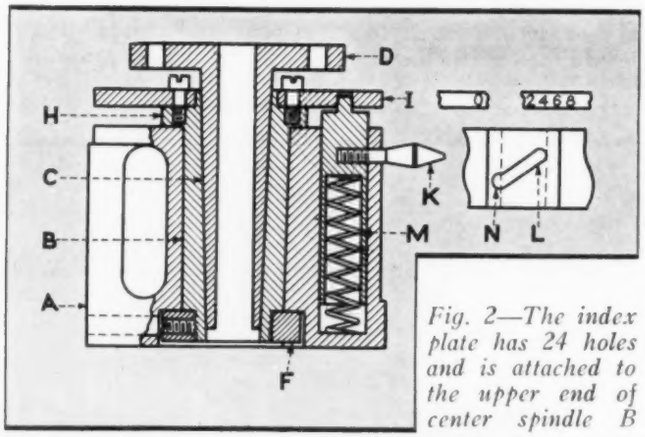


Fig. 2—The index plate has 24 holes and is attached to the upper end of center spindle B

pulled to the left, its shank travels down the helical slot, withdrawing the index pin from the hole in the index plate and compressing the spring. When the shank of the handle reaches the lower part of the helical slot, it engages the rounded notch *N* and is locked in the out position by pressure of the spring.

Attached to the chuck plate is a 3-in. three-jaw scroll chuck provided with interchangeable jaws. Since the accuracy of the device depends upon that of the chuck, for precision work the work can be mounted on a faceplate attached to the chuck plate.

Hollowed Oilstones Should Be Trued

By CHARLES LITTLE

Several authors have given their methods for truing oilstones (*AM*—Vol. 83, page 919 and Vol. 84, page 140). An additional method is to clamp the oilstone in a shaper vise with toe clamps or holddown bolts, using light pressure to avoid breaking the stone, and face the stone with a diamond-point emery-wheel dressing tool. The latter should be mounted in the shaper tool holder with a negative rake angle of approximately 5 deg. Depth of cut should be 0.005 in., feed should be between 0.005 and 0.010 in., and the cutting speed the same as used for steel.

I use a tool $\frac{7}{16}$ in. in diameter and 2 in. long, which has five diamonds placed on the center line of the tool one above the other. After one point is worn away, the next one is brought into service by grinding the metal back and repointing the tool. In this manner one tool will true several hundred oilstones.

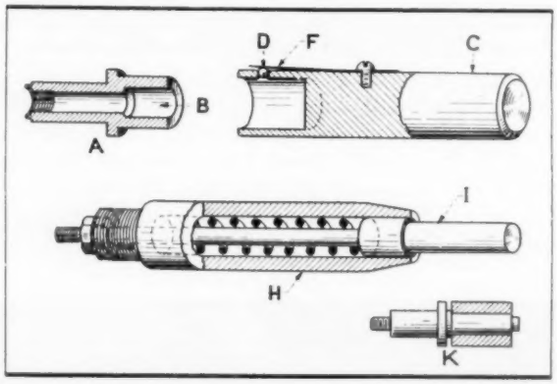
Increasing Production in the Screw Machine

BY E. O. SCHRAY

We had to make a large quantity of brass parts such as the one at *A*, the work being done in a No. 00 B & S automatic screw machine in two operations. The first operation consisted of drilling and tapping the small hole, Forming and cutting off. All these were done by usual screw-machine methods with conventional tools.

The second operation consisted of drilling the hole *B* in the large end, and some means had to be devised for holding the work so that it could be put in the collet as soon as the first piece drilled was ejected, so we made the holder *C* to be held in the turret. It has a hole to fit the large end of the work which was held therein by the ball *D* backed by the flat spring *F*. For ejecting the finished work we made the sleeve *H* carrying the spring actuated plunger *I*, the sleeve being attached to the feed tube, taking the place of the feed finger.

The operation cycle is as follows: A piece is put in the holder and as the turret advances it is automatically transferred to the collet, pushing in the plunger against pressure of the spring. Then the collet closes and the turret backs away, leaving the work in the collet. The turret then indexes, bringing the drill into position and drilling begins. While the drill is cutting, the operator puts another piece in the holder.



Work in a holder is automatically transferred to the collet as the turret advances. Finished work is ejected by a spring plunger carried in a sleeve on the feed tube. Production is 600 pieces per hour

When the first piece has been drilled, the collet opens and the plunger ejects it, completing the machining cycle and producing finished piece.

Production is at the rate of 600 pieces per hour, but could have been speeded up by using double cams made for the job.

Some time later we had to make a large quantity of pieces such as the one at *K*, using a similar holder, sleeve and plunger. The second operation was turning the small end which could not be finished by forming because of its small diameter and the smoothness and close tolerance required.

The Working of MAGNESIUM ALLOYS

MAGNESIUM-BASE alloys have characteristics which make them stand apart from other metals. For one thing, they are the lightest structural alloys yet known, being two-thirds the weight of aluminum and one-fourth that of iron or steel. They also possess excellent machinability, toughness and fatigue endurance. They have a high strength-weight ratio. That is, on an equal weight basis their strength is equal or superior to that of most other metals.

Known in Europe as Elektron and Magnuminium metals and in the United States by such trade names as Dowmetal and Mazlo, magnesium-base alloys are available as sand, permanent mold and die castings, forgings, extruded shapes, and rolled plate, sheet and strip. Products made from these alloys are numerous. To name only a few—packaging machinery, portable tools, typewriters and other business machines, cameras, vacuum cleaners, airplanes, aircraft instruments and aircraft engine parts. Many assembly jigs and fixtures in metal-working plants now are made of magnesium-base alloys.

But such widespread applications are a comparatively recent development. Though first isolated as a metallic element early in the nineteenth century, this silvery-white metal was not used structurally until 1909. It was 1915, in fact, before the American magnesium industry really got its start. Structural uses in the United States did not reach significant proportions until about 1930.

Brines pumped from wells in central Michigan now are the principal source of magnesium in this country. A metal 99.8+ per cent pure is obtained by electrolytic reduction of magnesium chloride recovered from this brine. Recently the Dow Chemical Company, only American producer of the base metal now operating, announced plans for construction of a plant in Texas to recover metallic magnesium from sea water.

ALLOYING ELEMENTS

Like most pure metals, magnesium is soft and has low mechanical strength. However, when alloyed with other metals it is suitable for many applications. Aluminum, zinc and manganese, in varying amounts up to about 12 per cent, are the principal alloying elements. Copper, nickel, tin, cadmium, silver, silicon and other non-ferrous metals alloy with magnesium.

Aluminum is the most important element in magnesium-base alloys. Commercially important alloys in this group contain from 3 to 13 per cent aluminum. They also have small amounts of manganese, thereby increasing resistance to corrosion. The manganese, incidentally, has little effect on mechanical properties.

Silicon in quantities above 0.5 per cent tends to increase brittleness in a magnesium-base alloy. Certain elements, such as copper, iron or nickel, must be kept at a minimum to insure maximum resistance to corrosion. Zinc primarily adds to corrosion resistance. As the aluminum content grows, the grain structure becomes more refined, strength and hardness increase, and ductility diminishes. Alloys with more than 13 per cent aluminum are too brittle for structural use.

Magnesium-aluminum alloys are amenable to heat treatment involving solution and precipitation of the Mg_3Al_2 compound. Practically, heat treatment is most beneficial on alloys having from 6 to 13 per cent aluminum. Those containing from 8 to 13 per cent aluminum develop greater hardness and higher yield strength

PHYSICAL CONSTANTS OF PURE MAGNESIUM

Atomic weight	24.32
Specific gravity at 20 C. (68 F.), gm. per cu. cm	1.737
Weight at 20 C. (68 F.), lb. per cu. in	0.061
Melting point, degrees Fahrenheit	1,204
Boiling point, degrees Fahrenheit	2,007
Latent heat of fusion, B.t.u. per lb	126
Latent heat of vaporization, B.t.u. per lb	2,340 to 2,700
Mean specific heat (32 to 212 F.), cal. per g	0.249
Thermal Conductivity (32 to 212 F.), B.t.u. per sq. ft. per in. per deg. F. per hr	1,090 to 1,102
Mean coefficient of thermal expansion (68 to 572 F.)	0.0000157
Tensile strength, lb. per sq. in	27,000
Elongation in 2 in., per cent	15
Modulus of elasticity	6,500,000
Brinell hardness number (500 kg. load, 10 mm. ball)	37
Mean reflectivity, per cent for white light	73

This section was made possible through the cooperation of the following companies:

Aluminum Company of America
American Magnesium Corporation
Carboloy Company
Dow Chemical Company
Eclipse Aviation Corporation
Geometric Tool Company
Goddard & Goddard Company
Landis Machine Company
Morse Twist Drill & Machine Company
National Twist Drill & Tool Company
Nicholson File Company
Pratt & Whitney Aircraft Division, United Aircraft Corporation
Pratt & Whitney Division, Niles-Bement-Pond Company
Wright Aeronautical Corporation

when the solution heat treatment is followed by a precipitation or aging treatment. Heat-treated magnesium-aluminum alloys ordinarily are used for highly stressed castings. Magnesium alloys containing zinc in addition to aluminum are suitable for applications involving impact stresses. The magnesium-manganese alloys weld readily.

CASTINGS

Properties of magnesium-base casting alloys compare favorably with those of cast aluminum. A shrinkage factor of 5/32 in. per ft. is used for castings of moderate size or with unrestrained shrinkage; ⅛ in. per ft. is advisable for large castings. Wall thicknesses should not be less than 5/32 in. unless the areas are small and favorably placed in relation to the gates. It usually is possible to cast from patterns made for aluminum, some revision may be necessary on large patterns.

Solution heat-treated castings show increased tensile strength, ductility and toughness without change of yield strength or hardness, and are in the best condition for resistance to shock. When solution heat-treated and aged, castings show the highest tensile strength, yield strength and hardness, with somewhat reduced ductility. This is the best condition for applications not subject to shock. The solution heat treatment is performed at temperatures from 630 to 785 F., depending on the alloy, followed by air cooling. Aging, or precipitation, is done at approximately 350 F. Accurate control of temperature is essential. Room temperature aging of magnesium-base alloys proceeds more slowly than is the case with most solution heat-treated aluminum alloys, and for most applications can be ignored.

At the present time the most widely used alloy for sand castings contains from 5.3–6.7 per cent aluminum, 0.15 per cent manganese and 2.5–3.0 per cent zinc. Castings made from this alloy are given a heat treatment consisting of heating to 630–640 F., holding at heat for five hours. The temperature then is increased to 710–720 F. and held for 14 hr. Sometimes a single-step treatment of 12 hr. at 730 F. is used. The solution heat treatment is followed, after cooling in air, by a precipitation treatment in which the parts are heated to 350 F. and held at heat for 16 hr., after which they again are cooled in air. Parts which are found to warp during machining may be rough machined and then given a second aging treatment consisting of heating to 400 F. and holding at heat for two hours.

Permanent-mold castings, which have a finer grain than the same composition when sand cast, should be considered when quantities required justify additional mold cost. Sometimes as few as 500 castings can be made more economically as permanent-mold castings. In many cases semi-permanent molds with sand cores are desirable where it is not possible or economical to use full permanent equipment.

Magnesium-base alloys are well adapted to the die-casting process. Dimensional accuracy, smoothness of surface, minimum of necessary machining and low cost per piece are advantages of magnesium die castings. Fabrication cost per piece closely approaches that for aluminum. High pressure "well and plunger" type casting machines are recommended. Die design is similar to that employed in aluminum die casting practice. Gates and vents require special consideration; larger fillets and the rounding of sharp corners are advantageous.

An unusual example of the possibilities of the use of magnesium-base alloys, cited by H. Altwicker of Germany at an S.A.E. meeting in New York in 1939, is the use of mag-

WEIGHTS OF STRUCTURAL METALS

Material	Weight	
	lb./cu.in.	lb./cu.ft.
Magnesium Alloys	0.065	112
Aluminum Alloys	0.101	175
Zinc	0.256	443
Cast Iron	0.260	450
Tin	0.264	456
Steel	0.285	493
Brass	0.307	531
Bronze	0.318	550
Nickel	0.322	556
Copper	0.322	556
Lead	0.408	706

INDEX TO SPECIFICATIONS FOR MAGNESIUM-BASE ALLOYS

FORM	Dow Chemical Company — Dowmetal	American Magnesium Corporation — Mazlo	American Society for Testing Materials		Navy Bureau of Aeronautics		Army Air Corps	
			Alloy No.	Specification	Alloy No.	Specification	Alloy No.	Specification
SAND CASTINGS	G	AM240	2	B80-38T	..	....	....	....
	H	AM265	4	B80-38T	4	M-112	....	57-74-1 C
	M	AM403	..	.....	11	M-112	....	....
DIE CASTINGS	K	AM230	12	B94-39T	..	M-369	Grade 1	11319
	R	AM263	13	B94-39T	..	M-369	Grade 1	11319
FORGINGS	A	....	1	B91-38T	..	....	....	....
	F	....	6	B91-38T	..	....	....	....
	J	AM57S	8	B91-38T	..	....	....	....
	M	....	..	.....	11	M-126	....	....
	O	AM58S	9	B91-38T	..	....	....	....
	X	AM74S	15	B91-38T	..	....	....	....
	..	AM65S	16	.....	..	....	....	....
	J-1	AMC57S	..	.....	8	M-126	....	....
	O-1	AM58S	..	.....	9	M-126	....	11321
	X-1	AM74S	..	.....	15	M-126	....	....
EXTRUDED BARS, RODS AND SHAPES	F	....	6	B107-38T	..	....	....	....
	J	AM57S	8	B107-38T	..	....	....	....
	O	AM58S	9	B107-38T	..	....	....	....
	M	AM3S	11	B107-38T	11	M-314	Grade 2	11320
	X	AM74S	15	B107-38T	..	....	....	....
	J-1	AMC57S	..	.....	8	M-314	Grade 1	11320
	X-1	AM74S	..	.....	15	M-314	Grade 1	11320
EXTRUDED TUBING	J	AM57S	8	B107-38T	..	....	....	....
	M	AM3S	11	B107-38T	11	M-366	Grade 2	11318
	X	AM74S	15	B107-38T	..	....	....	....
	J-1	AMC57S	..	.....	8	M-366	Grade 1	11318
	X-1	AM74S	..	.....	15	M-366	Grade 1	11318
ROLLED STRIP, SHEET AND PLATE	F	AM53S	6	B90-38T	..	....	....	....
	E	....	7	B90-38T	..	....	....	....
	M	AM3S	11	B90-38T	11	M-111	....	11317

nesium-alloy castings as die blocks for forming light sheet metal. He stated that recent experiments have shown that steel sheet can be formed in magnesium dies without appreciable die wear, and described cast magnesium die blocks for forming sheet in drop-hammer presses.

FORGINGS AND EXTRUSIONS

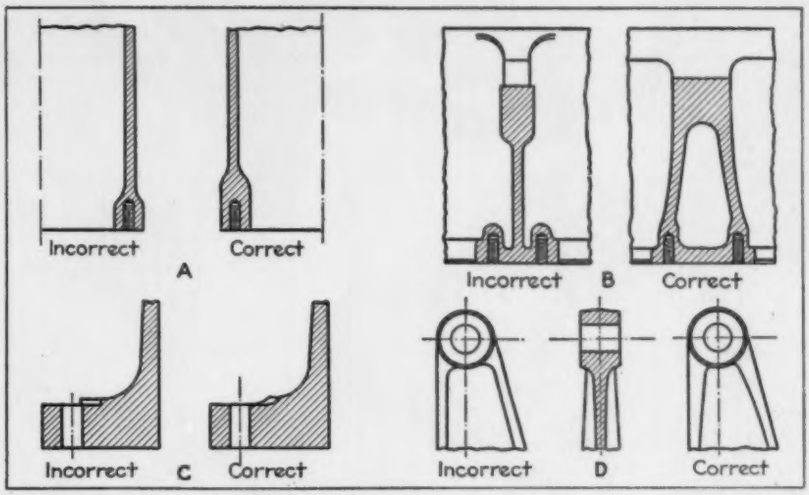
Usually made from extruded stock, since extruded material allows a wider forging temperature range and greater speed of forging than do cast blanks, forgings of magnesium-base alloys can be made with press or in some cases with hammer equipment. The alloys are plastic within the range of 500 to 750 F. Hammer forgings usually are less expensive than pressings, and are satisfactory for moderately stressed applications. Press forgings are recommended where maximum strength is required. These alloys are not usually heat-treated after forging, but for alloys like Dowmetal *O* and *X* or Mazlo AM58S and AM74S, maximum properties can be obtained by aging 24 hr. at 350 F. Dies designed for use with other metals ordinarily can be used when forging magnesium-base alloys, since draft and shrinkage variations are slight.

Bars, rods, structural shapes, special sections, and tubing are produced from magnesium-base alloys in a wide variety of forms and sizes by the extrusion process, permitting shapes to be made that are not possible by rolling. The alloys can be extruded into practically any shape for which die equipment can be constructed. Bars 7 in. in diameter and tube 7 in. outside diameter have been made by this process.

Rolled magnesium-base alloys are available as plate, sheet, strip and ribbon. Sheet is furnished in hard-rolled and annealed tempers; plate as "hot rolled." Hard-rolled material is used for parts requiring maximum yield strength and not subject to high impact or shock loads. Where maximum flatness is required, or where forming operations are to be performed, annealed sheet material is best. This has a lower yield strength and greater ductility than hard-rolled sheet. The most workable materials are in thicknesses less than $\frac{1}{8}$ in.

DESIGN HINTS

While the basic principles of mechanics apply, of course, to the design of magnesium-base alloy parts, practices which are more or less



Design Tips—(A) Ample metal must be provided at the ends of stud bosses. (B) Connect stud bosses so as to distribute the load. (C) Spotfacing tools should have radius to cut a fillet, as at right. (D) Properly designed section junctions remove points of stress concentration

standard with the ferrous metals are not always best for these alloys. Lighter weight of magnesium-base alloys makes possible the use of stiffeners, larger fillets or thicker webs without undue weight penalty.

Generally speaking, not all of the theoretical weight saving can be realized when allowances have been made for differences in strength and modulus of elasticity. The generally accepted value for modulus of elasticity for magnesium-base alloys is 6,500,000 lb. per sq. in. This is lower than the modulus for aluminum and considerably lower than for steel. Likewise the coefficient of thermal expansion is slightly higher than that for aluminum. The strength of magnesium-base alloys decreases with increased temperature. Usually they are not adaptable for use at temperatures above 400 F.

Unlike steel, but similar to aluminum alloys in this respect, magnesium-base alloys do not exhibit sharp yield points when subjected to the usual tensile tests. There is a very gradual breaking away from the modulus line, making determination of the tangential proportional limit somewhat difficult. Yield strength now is accepted as the point where the stress-strain curve deviates 0.2 per cent from the modulus line. The usual value obtained for the proportional limit is from 50 to 60 per cent of the yield strength. Endurance limit, as determined by the usual rotating beam test, is high for magnesium-base alloys, particularly in the wrought condition.

In practice, necessary fabrication methods frequently will not permit attainment of ideal stress distribution in a given part. Sharp corners and notches must be avoided; generous fillets, beads around wall openings and carefully driven rivets are factors necessary if stress concentrations are to be avoided and the structure is to have maximum fatigue strength.

Adequate finish metal should be allowed on casting surfaces that are to be machined. Ample metal should be provided in bosses to be drilled. A length of twice the stud diameter is satisfactory for U.S.S. threads; for S.A.E. threads the length should be $2\frac{1}{2}$ to 3 times the stud diameter. Stud bosses should have ample metal left around the ends of holes. Bosses which carry heavy loads, whether steady or intermittent, should be connected to the structural members by walls or ribs so that the loading will be distributed over large areas.

In joining, a relatively large number of small bolts, screws or studs is preferable to a few of large dimensions. Spotfacing operations that cut or nick the casting, leaving a sharp corner, are to be avoided. It is recommended that cutters be rounded at the corner so that a fillet is left in the corner of the spotface cut. Particular attention should be paid to section changes. Where a relatively thin wall joins a thicker wall, boss or other mass, the wall should be tapered gradually so as to blend into the heavier section. Fillets should be in proportion to the thickness of the sections they join. In most instances the fillet should have a radius equal to the thicker section. Washers should be used under bolt heads and nuts in all cases.

PHYSICAL CHARACTERISTICS OF TYPICAL

TYPICAL MAGNESIUM-BASE ALLOYS				CHEMICAL COMPOSITION Per Cent (Magnesium = Remainder)						Specific Gravity (Approx.)	Weights (Approx.) Lb. per Cu. In.	Available Condition	Rel. Resistance to Salt Water ("A" Rating is highest) [4]	Melting Point — Deg. F.	Temperature of Incipient Fusion — Deg. F.
A.S.T.M. Designation		Dow Chemical Company —	American Magnesium Corporation —												
Spec. No.	Alloy	Dowmetal	Mazlo	Aluminum	Manganese (Minimum)	Zinc	A = Cadmium B = Tin	Silicon (Maximum)	Total Impurities (See Notes) [1]						
Sand and Permanent — Mold Castings															
.....	....	C	.....	8.3 – 9.7	0.10	1.7–2.3	.....	0.5	0.3	1.82	0.066	As Cast	....	....	.....
.....	....	C	.....	8.3 – 9.7	0.10	1.7–2.3	.....	0.5	0.3	1.82	0.066	Heat Treated	....	....	.....
.....	....	C	.....	8.3 – 9.7	0.10	1.7–2.3	.....	0.5	0.3	1.80	0.065	H. T. & Aged	....	....	.....
B80-38T	2	G	AM240-C	9.0 –11.0	0.10	0.3 max.	.. ..	0.5	0.3	1.81	0.066	As Cast	D	1100	816
B80-38T	2	G	AM240-T4	9.0 –11.0	0.10	0.3 max.	.. ..	0.5	0.3	1.81	0.066	Heat Treated	D	1100	855
B80-38T	2	G	AM240-T61	9.0 –11.0	0.10	0.3 max.	.....	0.5	0.3	1.81	0.066	H. T. & Aged	D	1100	855
B80-38T	3	.....	AM246-C	11.2 –12.8	0.10	0.3 max.	.....	0.5	0.3	1.82	0.066	As Cast	C+	1075	816
B80-38T	3	.....	.....	11.2 –12.8	0.10	0.3 max.	.....	0.5	0.3	1.82	0.066	Heat Treated	....	....	.....
B80-38T	3	.....	AM246-T6	11.2 –12.8	0.10	0.3 max.	.....	0.5	0.3	1.82	0.066	H. T. & Aged	C+	1075	816
B80-38T	4	H	AM265-C	5.3 – 6.7	0.15	2.5–3.5	.....	0.5	0.3	1.84	0.066	As Cast	B	1155	760
B80-38T	4	H	AM265-T4	5.3 – 6.7	0.15	2.5–3.5	.....	0.5	0.3	1.84	0.066	Heat Treated	B	1155	760
B80-38T	4	H	AM265-T6	5.3 – 6.7	0.15	2.5–3.5	.....	0.5	0.3	1.84	0.066	H. T. & Aged	B	1155	760
B80-38T	14	P	.....	9.0 –11.0	0.10	0.5–1.5	.....	0.5	0.3	1.82	0.066	H. T. & Aged	C	....	.....
.....	....	M	AM403-C	.. ..	1.20	.....	.....	0.3	0.3	1.76	0.064	As Cast	A	1200	1200
.....	....	.....	AM241-T4	7.0 – 9.0	0.15	0.3 max.	.....	0.3	0.3	1.80	0.065	Heat Treated	E	1120	915
.....	....	.....	AM244-C	3.5 – 5.0	0.20	0.3 max.	.....	0.5	0.3	1.76	0.064	As Cast	D	1160	1050
.....	....	.....	AM260-C	8.75– 9.25	0.10	1.8–2.2	.....	0.3	0.3	1.82	0.066	As Cast	B	....	.....
.....	....	.....	AM260-T4	8.75– 9.25	0.10	1.8–2.2	.....	0.3	0.3	1.82	0.066	Heat Treated	B	....	.....
.....	....	.....	AM260-T6	8.75– 9.25	0.10	1.8–2.2	.....	0.3	0.3	1.82	0.066	H. T. & Aged	B	....	.....
Die Castings															
B94-39T	12	K	AM230-C	9.0 –11.0	0.10	0.3 max.	.....	1.0	0.3	1.81	0.066	Die Cast	B	1100	816
.....	....	.....	AM241-C	7.0 – 9.0	0.15	0.3 max.	.....	0.3	0.3	1.80	0.065	Die Cast	D	....	.....
B94-39T	13	R	AM263-C	8.3 – 9.7	0.10	0.4–1.0	.....	0.5	0.3	1.81	0.066	Die Cast	B	....	.....
.....	....	EX	.....	5.8 – 7.2	0.15	0.3 max.	.....	0.3	0.3	....	.....	Die Cast	B	....	.....
Forgings															
B91-38T	1	A	.....	7.8 – 9.2	0.15	0.3 max.	.....	0.5	0.3	1.80	0.065	Pressed	....	....	.....
B91-38T	6	F	.....	3.3 – 4.7	0.20	0.3 max.	.....	0.5	0.3	1.77	0.064	Forged	....	....	.....
B91-38T	8	J	AM57S	5.8 – 7.2	0.15	0.4–1.0	.....	0.5	0.3	1.81	0.066	Pressed	D	1150	950
.....	....	J-1 [3]	AMC57S	5.8 – 7.2	0.15	0.4–1.5	.....	0.5	0.3 [2]	1.80	0.065	Pressed	B+	1150	950
.....	....	L	.....	1.8 – 3.2	0.20	0.3 max.	2.8–4.2(A)	0.5	0.3	....	.....	Hammered	D	....	.....
B91-38T	9	O	AM58S	7.8 – 9.2	0.15	0.2–0.8	.....	0.5	0.3	1.83	0.066	Pressed	C	1110	895
B91-38T	9	O	AM58S-T	7.8 – 9.2	0.15	0.2–0.8	.....	0.5	0.3	1.83	0.066	Pr. & Aged	E	....	.....
.....	....	O-1 [3]	.....	7.8 – 9.2	0.15	0.2–0.8	.....	0.5	0.3 [2]	1.83	0.066	Pressed	B	....	.....
B91-38T	15	X	AM74S	2.5 – 3.5	0.20	2.5–3.5	....	0.5	0.3	1.82	0.066	Forged	B+	....	.....
B91-38T	15A	X	AM74S-T	2.5 – 3.5	0.20	2.5–3.5	.....	0.5	0.3	1.82	0.066	Forged & Aged	B+	....	.....
.....	....	X-1 [3]	.....	2.5 – 3.5	0.20	2.5–3.5	.....	0.5	0.3 [2]	1.82	0.066	Forged	B+	....	.....
B91-38T	16	.... . .	AM65S	3.0 – 4.0	0.20	0.3 max.	4.0–6.0(B)	0.5	0.3	1.87	.....	Hammered	C	....	.....
Extruded Bars, Rods and Shapes — Extruded Tubing															
B107-38T	6	F	.....	3.3 – 4.7	0.20	0.3 max.	.....	0.5	0.3	1.77	0.064	As Extruded	E	....	.....
B107-38T	8	J	AM57S	5.8 – 7.2	0.15	0.4–1.0	.....	0.5	0.3	1.80	0.065	As Extruded	D+	1150	950
.....	....	J-1 [3]	AMC57S	5.8 – 7.2	0.15	0.4–1.5	.....	0.5	0.3 [2]	1.80	0.065	As Extruded	A	1150	950
B107-38T	9	O	AM58S	7.8 – 9.2	0.15	0.2–0.8	.....	0.5	0.3	1.81	0.066	As Extruded	C	1110	895
B107-38T	9	O	AM58S-T	7.8 – 9.2	0.15	0.2–0.8	.....	0.5	0.3	1.82	0.066	Extr. & Aged	D	1110	895
.....	....	O-1 [3]	.....	7.8 – 9.2	0.15	0.2–0.8	.....	0.5	0.3 [2]	1.81	0.066	As Extruded	B	1110	895
B107-38T	11	M	AM3S	.....	1.20	.....	.....	0.3	0.3	1.76	0.064	As Extruded	A	1200	1200
B107-38T	15	X	AM74S	2.5 – 3.5	0.20	2.5–3.5	..... .	0.5	0.3	1.81	0.066	As Extruded	B	....	.....
B107-38T	15A	X	AM74S-T	2.5 – 3.5	0.20	2.5–3.5	.....	0.5	0.3	1.81	0.066	Extr. & Aged	B+	....	.....
.....	....	X-1 [3]	.....	2.5 – 3.5	0.20	2.5–3.5	.....	0.5	0.3 [2]	1.81	0.066	As Extruded	B+	....	.....
.....	....	.....	AM52S	2.5 – 3.0	0.20	1.3 max.	.....	0.5	0.3	1.79	0.065	As Extruded	B	....	.....
Rolled Strip, Sheet and Plate															
B90-38T	6	F	AM53S-H	3.3 – 4.7	0.20	0.3 max.	.....	0.5	0.3	1.77	0.064	Hard Rolled	D	1160	1050
B90-38T	6	F	AM53S-O	3.3 – 4.7	0.20	0.3 max.	.....	0.5	0.3	1.77	0.064	Annealed	D	1160	1050
B90-38T	6	F	AM53S-R	3.3 – 4.7	0.20	0.3 max.	.....	0.5	0.3	1.77	0.064	Hot Rolled	....	1160	1050
B90-38T	7	Eh	.....	5.8 – 7.2	0.15	0.3 max.	.....	0.5	0.3	1.79	0.065	Hard Rolled	E	....	.....
B90-38T	7	Ea	.....	5.8 – 7.2	0.15	0.3 max.	.....	0.5	0.3	1.79	0.065	Annealed	E	....	.....
B90-38T	11	Mh	AM3S-H	.....	1.20	.....	.....	0.3	0.3	1.76	0.064	Hard Rolled	A	1200	1200
B90-38T	11	Ma	AM3S-O	.....	1.20	.....	.....	0.3	0.3	1.76	0.064	Annealed	A	1200	1200
B90-38T	11	M	AM3S-R	.....	1.20	.....	.....	0.3	0.3	1.76	0.064	Hot Rolled	B	1200	1200

Notes:

[1] Copper, max., 0.05 per cent; nickel, max., 0.03 per cent; unless otherwise noted.

[2] Iron, 0.005 per cent; nickel, 0.005 per cent. Conforming to present Army and Navy specifications.

[3] These alloys are specially processed to insure freedom from impurities and have improved resistance to salt water.

[4] "A" rating is highest. In ordinary atmosphere the various alloys are approximately equivalent and have good corrosion resistance. Rating is based on relative stability of all magnesium-base alloys as a group.

CAST & WROUGHT MAGNESIUM-BASE ALLOYS

Thermal Conductivity Approx.—C. G. S. Units	Electrical Conductivity Percent Annealed Copper	Tensile Strength [6] (1,000 Lb. per Sq. In.)		Yield Strength [6] (1,000 Lb. per Sq. In.)		(Typical) Elongation in 2-in. (Per Cent)	(Typical) Compressive Strength (1,000 Lb. per Sq. In.)	(Typical) Shear Strength (1,000 Lb. per Sq. In.)	Rockwell E Hardness	Brinell Hardness (500 Kg. Load — 10 mm. Ball)	Impact — Izod (Ft.-Lb.)	Impact — Charpy (Ft. Lb.)	Fatigue Endurance Limit [7] (1,000 Lb. per Sq In.)	Hot Working Temperature Range (Degrees Fahrenheit)	CHIEF CHARACTERISTICS AND APPLICATIONS [8]
		Typical	Minimum *=Max.	Typical	Minimum										
.....	....	24	20	14	10	2	.....	.....	68	60	1	....	....	.....	Used where maximum pressure tightness is required. Equal to Dowmetal H in resistance to salt water.
.....	....	39	30	14	10	10	.....	.....	66	59	4	....	....	.....	
.....	....	39	32	21	17	3	.....	.....	85	77	1	....	....	.....	
0.17	11.5	22	18	13	10	2	48	18	65	54	2	0.6	9	.....	Can be gas welded. For applications requiring relatively high strength and leak-proofness.
0.17	9.9	35	29	12	10	9	50	20	62	52	4	2	11	.....	
0.17	12.5	36	29	19	17	2	54	22	80	69	2	0.7	9	.....	General purpose alloy.
0.16	10.5	19	17	14	11	0.5	.....	17	....	65	....	0.4	6	.....	In heat-treated and aged condition develops highest hardness now possible with magnesium-base alloys.
.....	....	....	....	....	....	....	.....	.....	....	....	....	....	....	.....	
0.16	12.5	32	27	20	17	0.5	.....	19	....	85	....	0.5	7	.....	
0.18	15.0	27	24	12	10	6	45	18	59	55	3	1.0	11	.....	Offers best combination of salt water resistance and mechanical properties. Can be gas welded, with some limitations.
0.18	12.5	38	30	12	10	11	46	18	60	55	5	2.5	11	.....	
0.18	13.8	38	32	19	16	5	50	20	74	70	2	1.1	10	.....	
.....	....	36	30	22	19	1	59	20	85	77	1	....	8	.....	Limited weldability, low shock resistance.
0.30	26.5	14	12	4.5	4	5	27	11	3	33	9	3.0	....	.....	Weldable. For lightly-stressed applications.
0.18	11.5	33	29	11	9	10	.....	18	....	48	....	2.2	7.5	.....	High elongation and resistance to shock.
0.23	17.2	24	20	9	8	6	.....	14	....	44	....	2.0	....	.....	Used for fittings for AM538 sheet tanks.
.....	....	23	20	14	10	1	.....	18	....	65	....	0.5	9	.....	Newly developed alloy with good foundry characteristics, stability and high mechanical strength.
.....	....	39	30	14	10	10	.....	20	....	63	....	2.0	9	.....	
.....	....	38	32	20	17	3	.....	22	....	78	....	0.8	9	.....	
0.17	11.5	31	29	22	....	1	.....	.....	74	62	1	0.5	....	.....	Standard die casting alloy.
.....	....	30	....	17	....	2.5	.....	.....	....	53	....	....	....	.....	More ductile than Mazlo Alloy No. AM230-C.
.....	....	34	29	21	....	5	.....	.....	72	60	2	....	....	.....	Standard die casting alloy. Weldable. Ductile.
.....	....	27	....	17	....	4	.....	.....	59	50	3	....	....	.....	For applications subject to shock. Strong and tough.
.....	....	....	42	24	....	5	.....	.....	....	....	....	....	....	.....	Recommended for press forgings.
.....	....	....	34	19	....	6	.....	.....	....	....	....	....	....	.....	Weldable. Replaced by Dowmetals J and X.
0.19	12.5	42	38	26	22	10	.....	21	68	57	....	2.2	17	550–775	Weldable. Has good strength and resistance to salt water.
0.19	12.5	42	38	26	22	10	.....	21	68	57	....	2.2	17	550–775	
... .	....	37	34	26	19	11	.....	. . .	61	51	....	. .	10.5	500–825	Recommended for hammer forgings.
0.18	10.8	45	42	30	24	8	.....	22	86	78	....	1.8	18	600–725	High-strength, simple forgings. Weldable. Can be heat-treated after forging to improve strength and hardness.
....	...	46	42	33	27	6	.....	.....	88	82	....	....	18	600–725	
.....	....	45	42	30	24	8	.. ...	.....	86	78	....	....	18	600–725	
.....	...	41	38	24	20	16	.....	.....	71	59	....	....	17	550–750	More corrosion resistant than Dowmetal O, but is less weldable. Also is improved by heat-treatment.
.....	....	42	38	28	22	14	.....	.....	74	62	....	....	17	550–750	
.....	....	41	38	24	20	16	.....	.....	71	59	....	....	17	550–750	
.....	....	38	35	22	20	12	.....	16	....	52	....	2.0	10.5	.....	Recommended for hammer forgings.
....	....	40	37	29	25	16	59	20	53	47	....	....	14	.....	General purpose extrusion alloy. Weldable.
0.19	12.5	44	40	32	27	17	69	20	65	54	....	3.0	17	.....	Used in place of Dowmetal X when parts must be welded.
0.19	12.5	44	40	32	27	17	69	20	65	54	....	3.0	17	.....	
0.18	10.8	47	43	35	29	12	75	20	73	61	....	2.2	17	.....	Used for extruded bars or simple sections with high strength requirements.
0.19	11.5	51	45	38	33	9	73	22.7	....	70	....	1.6	16	.....	
0.18	10.8	47	43	33	28	11	75	20	73	61	....	....	17	.....	
0.30	34.5	42	33	30	23	7	53	18	40	42	....	2.1	8	.....	Moderately stressed parts. Weldable.
.....	....	42	39	30	26	19	72	20	61	51	....	....	18	.....	Best combination of salt water resistance, mechanical properties and extrusion characteristics. Not weldable.
.....	....	44	41	34	30	13	72	21	65	54	....	....	17	.....	
.....	....	44	41	34	30	13	72	21	65	54	....	....	17	.....	
0.23	17.2	40	37	30	25	17	60	19	....	50	....	3.2	12	.....	More easily fabricated than Mazlo Alloy AM57S.
0.23	17.2	44	36	35	25	4	.....	.....	72	60	....	....	....	.....	Higher mechanical properties than Dowmetal M, but is less resistant to corrosion and harder to form.
0.23	17.2	36	38*	22	....	10	.....	18.5	60	50	....	....	10	.....	
0.23	17.2	40	....	....	....	....	.....	.....	....	....	....	....	....	.....	
.....	....	45	39	34	28	9	.....	.....	81	70	....	....	....	.....	General purpose rolling alloy. Weldable. Resistance to salt water is low.
.....	....	39	42*	20	....	15	.....	.....	68	57	....	....	....	.....	
0.30	34.5	37	32	29	24	10	.....	.....	64	53	....	....	....	.....	Recommended for moderately-stressed applications where resistance to salt water is more important than mechanical properties.
0.30	34.5	32	35*	16	....	16	.....	17.5	56	48	....	....	8	.....	
0.30	34.5	34	....	19	....	13	.....	.....	49	47	....	....	....	.....	

Notes:

[6] Yield strength is defined as the stress at which the stress-strain curve deviates 0.2 per cent from the modulus line. Modulus of elasticity for these alloys may be taken as 6,500,000 lb. per sq. in.

[6] Mechanical properties are obtained on standard A.S.T.M. specimens.

[7] Fatigue endurance values are obtained on R. R. Moore machines and are based on 500 million cycles.

[8] Notes in this column necessarily are brief. Where a specific alloy is mentioned add " or equivalent "

SHOP PRACTICE FOR MAGNESIUM

Excellent machining characteristics are common to magnesium-base alloys. Compared with other commercially used metals, magnesium (1) allows higher cutting speeds, greater feeds and deeper cuts; (2) takes a smooth finish readily, does not drag or tear; (3) requires less power for equal volumes of metal removed; (4) castings are free from internal porosity, reducing machining scrap; (5) castings usually are free from hard spots; (6) is easier on machining equipment and parts are handled more easily by the operator; (7) chips clear work and tool better; and (8) if necessary, can be machined without a lubricant.

Experience has shown that practically all machine tools can be run at their maximum speeds with feeds to the full capacity of the machine. Cuts as heavy as ½ in. with feeds of 20 in. per min. and speeds of 700 ft. per min. are being used for turning magnesium-base alloy parts. Light finishing cuts have been made at speeds as high as 1,400 ft. per min. While machining occasionally is done dry, the use of *water-free* oil-type coolants is recommended for all power machining operations in order to eliminate fire hazards.

Ordinarily, standard tools can be used for machining these alloys, but they must be kept sharp. Best results, however, are possible only through the use of specially designed tools kept in the best operating condition. Extremely low cutting resistance, comparatively low heat capacity and large volume of chips obtained are major factors governing design of tools for magnesium-base alloys.

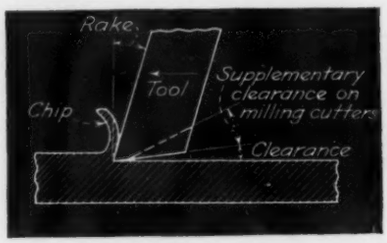
MACHINABILITY OF CAST METALS

Magnesium-base alloys	100
Aluminum alloys	55
Brass	45
Iron	30
Steel	20

Best tools have the following characteristics: (1) smooth tool faces, (2) large peripheral clearances, (3) large chip spaces and (in milling cutters) small number of blades, (4) small tool area in contact with work, and (5) comparatively small rake angles. In grinding the tools it is most essential to keep the cutting edges as keen and smooth as possible, and free from grinding scratches, burrs or wire edges. Tools tipped with tungsten carbide give good results and are recommended for maximum efficiency, especially where high speeds are used.

TURNING AND PLANING

A tool with a top rake of 10 to 20 deg., a side rake of 0 to 10 deg., and a clearance of 6 to 10 deg. is suited for most turning, shaping and planing operations. Round the nose of the tool in order to insure a smooth finish when finishing. Always back the tool away from the work when not cutting in order to minimize production of fine shavings which constitute a fire hazard. Broadnosed tools are used with a top rake of about 5 deg. to avoid chattering. An accompanying sketch shows four tools recommended by users of these alloys. Note that much variation in shape is permissible.



Tools for magnesium alloys should have small rake and large clearance angles. Chip space must be ample. Cutting edges should be honed sharp for best results

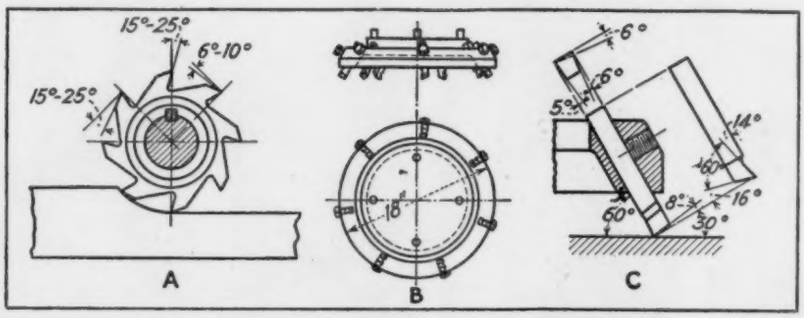
Large clearance angles are important on parting tools so as to reduce friction and avoid breakage of the tool. Some shops use little or no back rake, others employ a back rake of 15 to 20 deg. Minimum front and side clearance should be 6 deg. One supplier recommends a front clearance of 8 deg., side clearance of 8 to 10 deg. and side relief of 3 to 5 deg., with up to 20 deg. back rake for parting tools. Care must be taken that fine chips do not adhere to a heated parting or grooving tool, and that the chips do not rub between the walls of the groove and the tool.

MILLING

Peripheral speeds of as much as 5,000 ft. per min. occasionally have been used in milling magnesium alloy castings, taking ⅛ in. cuts with 0.045 in. feed in roughing, and 0.004 in. cuts with 0.015 in. feed when finishing. While such milling speeds still are considered exceptional, 1,000 to 3,000 ft. per min. are used in some shops. Because of spindle-speed limitations, such cutting speeds usually can be obtained only by using large diameter inserted-blade cutters. Milling cutters with magnesium bodies have been developed for extremely high speeds in order to reduce or eliminate vibration.

The highest feed in the capacity of the machine usually is satisfactory for roughing; feeds of 0.080 in. per rev. have been used. Heavy feeds result in a reduction of frictional heat and in freer cutting. Milling cutters for magnesium-base alloys should have fewer teeth, more undercut and helix angle, and more chip space than the average cutter of the same type designed for cutting steel.

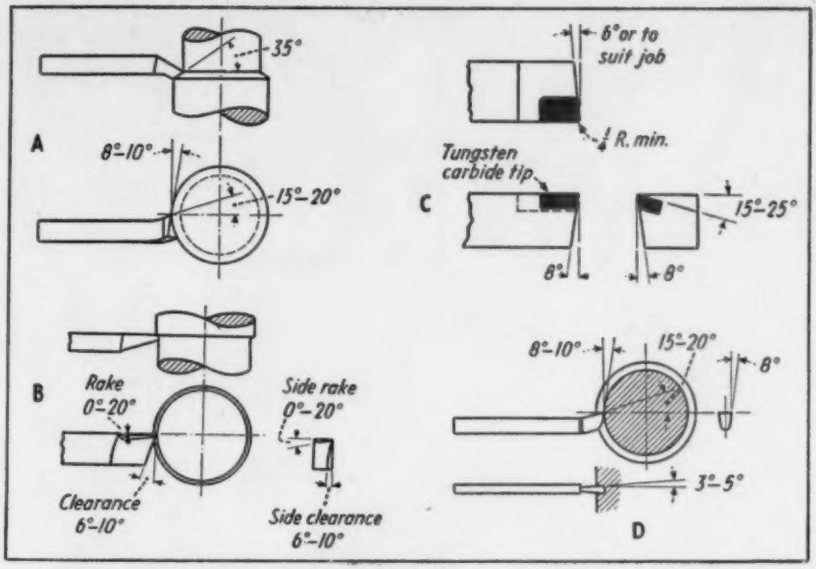
A rake or undercut of 15 to 25 deg. is satisfactory for face mills, solid cutters and plain mills, with a clearance of 6 to 10 deg. for 1/16 in. behind the cutting edge, followed by a secondary clearance of 15 to 25 deg. A helix angle of 15 to 45 deg. ordinarily is suitable. On straight forming cutters the rake can be reduced to 6–10 deg. to prevent chattering. On



Normal range of cutter-tooth angles for milling magnesium is shown at A. Helix angle should be 15 to 45 deg. At B and C are shown details of an inserted-blade face mill which has been used at 5,000 ft. per min.

ordinary milling operations speeds of 500 to 1,000 ft. per min. are practical, but will be dependent on cutter diameter, spindle speed and condition of the machine. One large user of the alloys, after considerable shop experience, has standardized on roughing speeds of 600 to 800 ft. per min. with cuts of $\frac{1}{8}$ in. or more and table feeds up to 30 ft. per min. by rapid traverse. Finishing speeds used by the same concern range from 1,000 to 1,500 ft. per min., using 15 to 25 in. per min. table traverse.

Inserted-blade milling cutters are satisfactory for machining these alloys, particularly since they provide the necessary chip room and permit high cutting speeds in the larger diameters. The blades, like lathe tools, should have a top rake of 15 deg. with ample clearance. Oil-type coolants are recommended for milling operations. On sections too thin properly to dissipate the heat, or where high speeds and relatively light feeds are being used, the coolant serves the double purpose of reducing the fire hazard and the possibility of distortion.



Tools shown at A, B, and C are used for turning, shaping and planing magnesium alloys. Surface is not smooth when tool has no back rake, but chips are broken up. Finishing tools have rounded nose. Parting tool, D, employs large clearance angles to reduce friction with work

DRILLING

Standard twist drills, sharply ground, are satisfactory for shallow holes in magnesium-base alloys. For high-speed production work, however, a drill having a helix angle of about 25 deg., a point angle of 120 to 130 deg. and a lip clearance of 15 to 20 deg. has been found best. Flutes should be large and highly polished to facilitate chip removal. A flat ground on each lip will reduce the rake and the tendency to hook into the work on breaking through. This tendency may also be overcome by using a drill with a helix angle of about 10 deg. Such a drill should be used only for short holes because of the difficulty of chip removal. Straight-flute drills can be used when drilling magnesium-alloy sheet.

When drilling deep holes, rapid chip removal is essential in order to avoid jamming the chips. Drills with a helix angle of 35 to 40 deg. and having large, polished flutes are best for this purpose. Holes as deep as four to fifteen times their diameter can be drilled readily without removing the drill for clearing the chips. The land should be about half of standard width. A small pilot spur or tip ground on the drill point will aid in producing accurate holes of considerable depth. The same effect often can be secured by grinding the drill point to a smaller included angle, such as 90 deg.

For holes more than $1\frac{1}{2}$ in. in diameter in solid metal, flat drills made by welding a sharp flat blade to a steel shank, as shown, are economical. Point angle should be 120 deg.; clearance, 15 deg.; ground-in-rake, 15 deg. Chip space is large; use of an air blast through the hollow shank will eliminate any possibility of chips jamming. On thick-blade drills of this type larger than $2\frac{1}{2}$ in. it has been found advisable to provide a thin extended tip at the center. This tip should be about $\frac{3}{4}$ in. in width and ground in the same way as the body of the blade.

High speeds and relatively heavy feeds facilitate chip removal and result in more accurate holes. Speeds up to 300 ft. per min. are used by many shops. Feeds vary from 0.010 to 0.020 in. or more per revolution. Variations in work as well as tools govern speeds and feeds that can be used when drilling magnesium.

REAMING

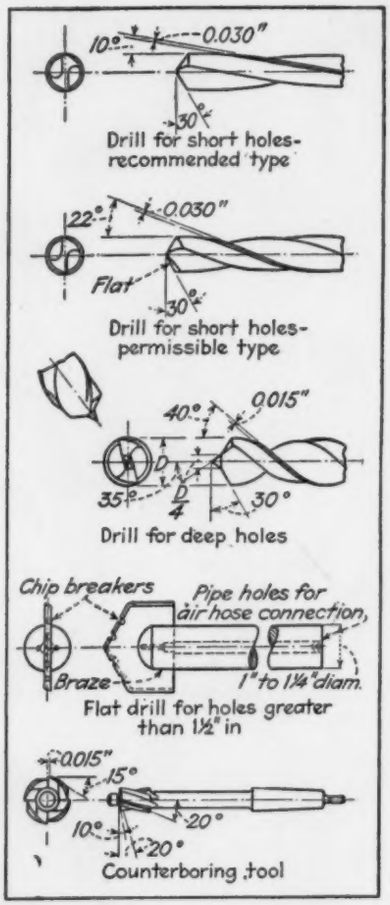
Left-hand helix (10 deg.), right-hand cut reamers with 4 to 6 deg. rake are preferable to straight-flute reamers for magnesium alloys. There should be no cylindrical land, but a 6 deg. relief behind the cutting edges is recommended. Very fine grit wheels should be used when sharpening these reamers. An entering taper 3/16 to $\frac{1}{4}$ in. long will aid in starting the reamer. An oil-type coolant (such as kerosene, or a mixture of three parts kerosene and one part lard oil) is suggested.

Counterbores should be ground similar to milling cutters, using about a 20 deg. helix angle and front rake, with a 10 deg. clearance at the cutting edge backed up by a secondary clearance of 15 to 25 deg. The cylindrical land of about 0.015 in. should be followed by ample relief and chip space. Spot facing cutters should have a rounded corner at the ends of the cutter, the radius of which should be 1/16 in. or more depending upon the diameter of the cutter.

THREADING

Little difficulty is experienced in threading commercially available magnesium-base alloys. They generally are free cutting, even at high speeds. Threading operations can be done dry; however, a 10 per cent lard oil and 90 per cent light mineral oil mixture diluted with 30 to 40 per cent kerosene may be used to wash away the chips and eliminate the fire hazard. Threading speeds can be as high as 100 ft. per min. when using dies with properly ground chasers. Speeds of 20 to 50 ft. per min. generally are more satisfactory, the actual speed depending on the pitch and length of thread. Use of a mechanical starting device which insures well-formed initial threads will make possible higher threading speeds. Chasers must have smooth surfaces and should be of the ground-thread type. They should be nitrided to give them a hard case.

The cutting edge of threading chasers must not be set over center as this agravates tearing and causes



Different drills are recommended for shallow and deep holes. A special flat drill is best for large holes. Counterbores are ground like milling cutters, but have a narrow land

overheating of the metal. In general chaser grinds that are suitable for aluminum work well with magnesium. Careful stoning of the cutting face and chamfer to produce a keen cutting edge will aid in producing smooth threads. Roll threading of these alloys is not satisfactory, since it involves excessive cold working of the metal.

TAPPING

Ground-thread taps of high-speed steel with three or four flutes are satisfactory for magnesium-base alloys. Spiral-pointed taps are recommended for through holes. Taps cut closer to size in these alloys than in most other metals and it sometimes is necessary to make them somewhat oversize if dimensions must be held closely. Each cutting face should have a rake or hook of 5 to 25 deg. The land should have little or no clearance, and the back of the land should be provided with a 5 deg. rake to permit the tap to cut rather than squeeze the metal as it is being backed out. Flutes should be large to provide adequate chip space. Lands should be narrower than usual. Tap chasers usually are furnished with a 20 deg. radial hook for either straight or taper threading.

COOLANTS

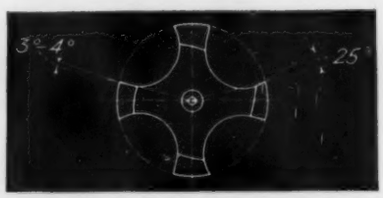
Although, with proper tools, magnesium-base alloys can be machined dry without difficulty, there is a fire hazard if the tools are allowed to become dull, particularly when taking fine cuts at high speed. The use of a coolant or lubricant is recommended to reduce this hazard and to give the smoothest finish to the work. Only oil-type coolants should be used. Kerosene or a higher flash point paraffin or petroleum oil, such as mineral seal oil, can be used. Lard oil may be added if desired. Vegetable oils are not recommended. Apply oil by pump in a generous stream if possible, otherwise brush oil on the part while machining. Water emulsions of soluble oil or other materials must not be used as fine magnesium shavings are a fire hazard when wet.

FILING

For hand work, single or double cut files may be used. Single cut files usually work better. Depending on smoothness desired, bastard, second cut or smooth files are used. Milled tooth files with curved teeth cut rapidly and leave a good finish. For rotary files, medium-coarse, single cut files are best.

SAWING

These alloys are cut readily by band or circular saws. Sharp blades are essential. Lubricating with a tallow stick often helps. Use spring-temper metal cutting band saws of 20-gage thickness with four teeth per inch. A finer pitch does not give sufficient clearance between the teeth. Set of the teeth should be greater than standard so as to reduce friction. Cutting speed should be about 4,000 ft. per min.



Back faces of each tap land should be ground with a hook, so that the tap will cut as it is backed out

Hand hacksaw blades should have 14 teeth per inch. Power hacksaws operate satisfactorily with 10 teeth per inch and may be run at their highest speed without burning the teeth. Sharp saws give best results. Metal-slitting circular saws should be coarse pitched and should have adequate side clearance.

DISTORTION

Distortion of magnesium parts during machining is infrequent. It generally can be attributed to one or more of the following causes: (1) dull tools; (2) tools with incorrect cutting angles, inadequate chip space or clearance; (3) too fine cuts and too low speeds; (4) too heavy cutting pressure on thin parts; (5) inadequate or improper clamping or chucking; and (6) dry machining of thin sections where the heat cannot be dissipated as rapidly as necessary —remedy for this is to use an oil-type coolant or reduce speed of operation.

FIRE PREVENTION

In order to ignite magnesium, it is first necessary to reach the melting point of the metal. Partial melting begins, depending on the alloy, at temperatures between 800 and 1,200 F. On heavy roughing cuts it is difficult to attain such temperatures. In finishing operations, however, where fine light shavings are produced, temperatures sufficiently high for ignition may be reached. It is because of this fact that it is necessary to emphasize the need for keeping the tools sharp, with adequate relief or clearance; for securing a true cutting action with as little friction as possible; and for the use of a coolant in high speed work. A coolant is advisable when machining castings with ferrous metal inserts, as sparking sometimes occurs when the tool strikes the insert.

Under no circumstances should water or any other type of standard fire extinguisher be used for extinguishing a magnesium fire, as this will make the fire more violent instead of smothering it. Anything that shuts off air from the burning chips will smother the fire. The best resort is to cover the chips with powdered soapstone, powdered asbestos, dry cast iron turnings, or powdered graphite, which should be kept in containers near the machine working on magnesium. Quick results often are ob-

tained by smothering the fire with an iron plate, or an asbestos mat or blanket. Smothering material should be applied gently so as to avoid scattering the light magnesium chips.

Care should be taken to avoid any accumulation of chips under or around the machine, for the danger of the spread of fire will be minimized if the amount of chips at the machine is small. It is important to avoid any accumulation of chips on the body or clothing of the operator. Goggles should be worn. A constant flow of oil-type coolant on the work being machined will, of course, eliminate much of the hazard encountered when machining dry. Sparks should be avoided and smoking nearby should not be permitted.

GRINDING

Medium-hard grinding wheels of melted clay bond with a grain size from 30 to 46 are recommended. A grain size of approximately 20 is recommended for snagging. The grinding of magnesium-base alloys involves a definite fire hazard. A liquid cooling agent, preferably an oil-type coolant or crude oil, should be used whenever possible. Oil vapors developed during grinding should be exhausted.

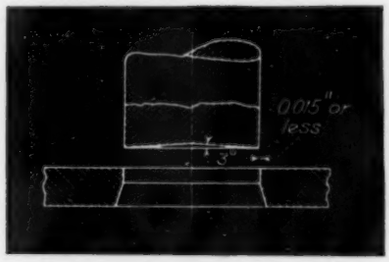
Grinding may be done dry, in cases where the use of a liquid coolant is not practical, if provision is made for exhausting the grinding dust at high suction speed (80 to 100 ft. per sec.). Grindings should be precipitated as soon as possible by means of a water spray, or they may be sucked into an overflow water tank. The exhaust system should be equipped with safety valves prevent explosion.

Certain precautionary rules should be observed by all concerned with the grinding of magnesium-base alloys. Grinding wheels must be marked *"For Magnesium Only"* and they must not be used for sparking materials. Sparking of any kind is to be avoided in the vicinity of equipment on which magnesium is ground. Machines and the surrounding floor should be kept clean; sweepings should be kept in a covered metal container and removed from the shop daily. Grinding dust is not recoverable and must be disposed of carefully after wetting with oil.

SHEET WORKING METHODS

Magnesium-base alloys lend themselves to such forming operations as bending, drawing, pressing and spinning. These alloys harden rapidly when cold worked and cold forming around small radii may lead to trouble. At elevated temperatures most of the alloys may be formed easily into intricate shapes. Hot forming is best done between 500 and 700 F., this temperature should be checked with a surface thermometer. Temperatures as low as 400 F. may be employed for moderate forming operations. Heating to above 750 F. lowers the mechanical properties of the alloys slightly. Above 800 F. the alloys become hot short and grain growth is promoted. Forming tools should be clean, smooth and well lubricated. Lard oil frequently is used, since it stands the heat well and can be removed easily with alkaline cleaners.

Blanking and shearing of thin sheet is accomplished as with other metals. With ordinary tools, blanked or sheared edges more than 0.065 in. thick tend to have a flaky structure. Special designs in punches and shear often will permit smooth cuts in stock up to several times this thickness. The use of an included angle of 60 deg. for the upper blade of power shears will permit cuts in plate up to ½-in. thick. As little clearance as possible should be used. Edge roughness should be dressed off the sheet to improve forming and fatigue characteristics, as well as paint adhesion. Heavy gages (⅛ in. or more thick) should be sawed rather than sheared when special equipment is not available for shearing clean edges.



Clearance between punch and die for magnesium must be held to minimum possible. A slight rake often helps the punch shear a smooth edge

When blanking or punching sheet, or flat and thin extruded stock, clearance between punch and die should be held to the minimum permitted by the accuracy of the press. A clearance of 0.015 in. or less is recommended. Smooth edges on sheet thicker than 0.065 in. can be obtained by warming the sheet to 500–600 F. before blanking. A slight rake (about 3 deg.) on the punch also will improve the sheared surface. If heating is necessary in this and subsequent operations, dimensional changes due to expansion during heating, and subsequent contraction, must be considered by the part and tool designers in order that the piece may be of proper size.

BENDING AND FORMING

Sharp corners and burrs must be removed from the edges of the sheet near the bend line if short-radius bends are to be made. Bend lines should not be scribed or prick-punched as such marks may lead to fatigue cracks. Minimum cold bending radius for sheet stock varies with the alloy, temper, thickness and rate of deformation. Type of equipment used and relation of axis of bend to direction of sheet rolling also influence results.

Annealed sheet stock has best cold forming properties. With such stock a bend radius of four times stock thickness usually is permissible under shop conditions. An actual trial should be made before determining minimum permissible radii. Hard rolled sheet can be given only a limited amount of cold bending. Such material usually can be bent around a radius of five to ten times stock thickness, the required radius tending to increase directly with thickness and amount of cold working.

Sharper bends can be made by hot bending; radii of 2 to 2½ times sheet thickness being obtained in the shop regardless of alloy or temper. In either hot or cold bending a slow rate of deformation will give best results. Heating for hot forming changes properties of hard-rolled sheet but does not change room-temperature properties of annealed sheet. Time of heating should be just enough to thoroughly heat the sheet. Speed of cooling in thin air and the low heat capacity of the metal require rapid handling and the use of preheated tools.

Sheets to be hot formed may be heated with a blow torch, in an oven or by dipping for several minutes in a hot oil bath. Use of ovens is recommended as the temperature then can be controlled accurately. The heating

of bending dies and the performance of the operation in a stream of hot air are two means frequently used to improve the bending of magnesium alloy parts. Local heating with a torch is difficult to control, but sometimes is necessary.

PRESSING AND DRAWING

While each case must be considered individually, draws and pressings of medium depth can be made successfully. Best results are obtained by heating the dies. Magnesium, aluminum or steel dies should be used. Dies of magnesium have the advantage of expanding at the same rate as the sheet being worked. Design of the dies follows closely that used for other metals. Where the forming operation is not severe and the work can be done cold, it sometimes is possible to adapt dies developed for other metals. It usually is necessary, however, to arrange for heating the dies. Ring-type gas burners have been used for this purpose; sometimes smaller dies can be heated electrically or with hand torches. When forming intricate shapes it often is advantageous to combine simple forming with welding. Production forming operations are carried out in: (1) cast dies forced together with a jack, (2) drop hammers, ordinarily using heated zinc or lead forms, (3) friction presses using the same forms, and (4) hydraulic presses using lubricated iron or steel dies. Tools should be clean, smooth and well lubricated. Lard oil often is used.

SPINNING

Only a small amount of spinning can be done cold. If the work is kept hot during the operation on the spinning lathe, magnesium alloys can be spun to shape without difficulty. Heat is applied by torch while the sheet is rotating. Depending on the severity of the deformation, a speed of 300 to 450 r.p.m. is recommended when spinning disks 15 to 25 in. in diameter. Laundry soap, or a mixture of two parts tallow and one part paraffin, is used to lubricate the work. The edge of the sheet should be filed clean before starting to reduce the risk of edge cracks. Wooden chucks are satisfactory if only a few pieces are to be made. Cast aluminum or magnesium chucks last longer.

RIVETING PRACTICE FOR MAGNESIUM

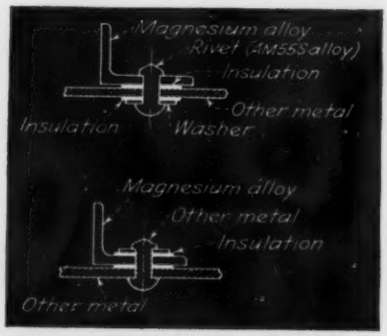
Riveting is the most satisfactory joining method used for the assembly of magnesium-base alloy structures. For thin sheets or lightly stressed parts pure aluminum (Alcoa 2S) rivets may be used as they are soft and can be cold-headed easily. Heavier sheets and stressed structures call for AM55S or Alcoa 56S aluminum alloy rivets, these alloys having been developed in order to reduce electrolytic action between the alloy and the rivet. Alcoa 17S-T, steel, copper, brass or bronze rivets are not recommended. With these materials the danger of electrolytic action, in the presence of moisture and insufficient paint protection, is increased materially. Magnesium-alloy rivets have been found unsatisfactory because of their low shear strength and the necessity for driving hot, even in small sizes. When possible, high-strength AM55S and Alcoa 56S rivets should be driven hot in sizes above ¼ in. diameter.

Proper design of riveted joints is essential if maximum strength is to be obtained. Bearing strength of magnesium alloy sheet is 60,000 to 70,000 lb. per sq.in. Based on a single shear value of 8,000 lb. per sq. in. for AM55S rivets, a rivet diameter of about 2½ times sheet thickness will give a balanced design. To avoid local stressing of the sheet, rivets should not be placed too close together. Minimum distance from a sheet edge to the center line of the first row of rivets is twice the rivet diameter for extruded edges. Add ⅛ in. for sheared edges. Minimum spacing between rivets should be three times rivet diameter plus ⅛ in. Rivets used in magnesium construction must not be welded over, as this would result in a brittle alloy.

Rivet holes should be drilled rather than punched, especially in heavy sheet and extruded sections. Parts to be assembled by riveting should be drilled separately or, if clamped together and drilled, should be disassembled for cleaning away all shavings. It sometimes is advisable to ream to size in the final assembly. Rivet shanks should fit the holes snugly, clearance should be not less than 1/64 and not more than 1/32 in. for rivets from ⅛ to ½ in. diameter. Loose joints must be avoided.

ASSEMBLY

The work should be assembled with bolts in alternate holes along the joint and rivets driven in remaining holes. After removing the bolts, the rest of the rivets may be driven. This practice maintains alignment of the parts and prevents the formation of collars on the rivets between the sheets.



Joints must be insulated with sealing compounds or gaskets, especially when exposed to water or salt air

The rivet shank should be just long enough to form the head when driving without causing too high a lateral stress in the sheet around the rivet hole. Whenever possible, rivets, especially in the larger sizes, should be driven with a squeeze riveter instead of a pneumatic hammer. Care must be taken to avoid damaging or overstressing the metal around the rivet hole.

Where corrosive conditions may be encountered in service, precautions must be taken to prevent corrosion of magnesium parts around the rivet. The severity of the corrosive conditions will largely influence the degree of insulation required. Where salt air or salt spray will be present, the rivet should be dipped into a suitable paint before placing it in the hole and driving. The excess paint squeezed from under the rivet head should be removed before painting the structure to prevent its bleeding through subsequent paint coatings.

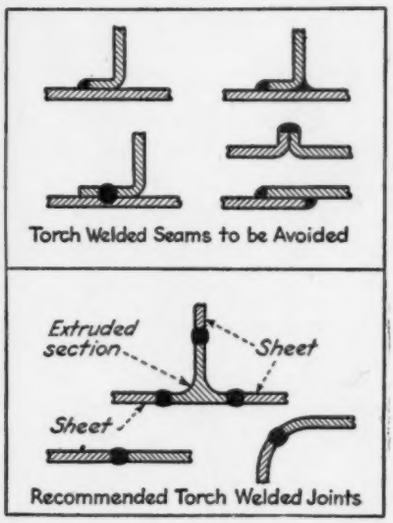
In order to minimize the possibility of corrosion within a riveted joint each contact or lapping surface should be given a coat of zinc chromate primer, such as U. S. Army Specification 14080 or Navy Aeronautical Specification P-27. Where joining surfaces are not perfectly flat, or where it is necessary to weather-seal joints, plastic, non-hardening joint sealers can be used.

WELDING AND SOLDERING OPERATIONS

Most magnesium-base alloys can be welded readily by the oxy-acetylene process. Electric resistance butt, seam and spot welding processes also can be used. The atomic hydrogen process and electric arc welding using carbon or metallic electrodes are not used commercially. The alloys cannot be welded successfully to other metals, nor can they be cut with the oxygen torch.

GAS WELDING

The oxy-acetylene flame affords protection to the molten metal, because of the non-oxidizing properties of the burned gases, and is recommended. The weld produced, using a rod of the approximate composition of the metal being welded, is equal in strength to good cast metal and



Weld seams which lap to form pockets in which flux can be trapped are not recommended for magnesium alloys

will have about 75 per cent of the strength of the parent metal. Procedure, so far as manipulation of the flame is concerned, is similar to that employed for aluminum and other metals. The torch should be adjusted to show a neutral flame.

When the welding rod is supplied with a chrome pickle (dichromate) coating, this should be removed with steel wool or a wire brush before using. A flux is necessary to prevent oxidation. Most suitable fluxes are supplied as a dry powder which is hygroscopic and must be stored in tightly closed glass bottles. They are prepared for use by mixing into a paste with water. The fluxes are used by brushing the paste on the parts and on the welding rod. By using only a small amount of flux there is less chance of flux inclusion in the weld and final cleaning is made easier.

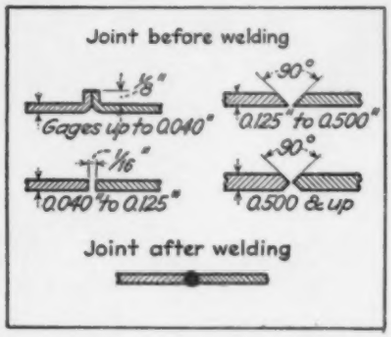
As the flux must be removed *completely* after welding, only butt welding is permissible. Any welds which form pockets or corners where the flux might become entrapped must be avoided. Surfaces to be welded must be cleaned carefully. Oil, grease and dirt can be removed with a solvent, or with an alkaline cleaner. Wire brushing is recommended around the surface to be welded; this is imperative if the article has been chemically treated.

Cleaned and fitted pieces are preheated to 500–600 F. and the flux applied to the edges of the sheet, both top and bottom, and the rod. The pieces then are tack welded at intervals of ½ to 3 in. along the seam, depending on the work. If the sheet warps during tacking it should be straightened with a wood mallet. After reheating and refluxing, the entire seam is welded and the sheet again straightened.

The flame should be held sideways, at an angle of about 30 deg. to the work, and in line with the seam. Thin sheet may be burned through if the 30 deg. angle is exceeded. If any part of the weld begins to oxidize or burn, welding must be stopped and the oxidized area cleaned by scraping or filing. To obtain a smooth weld, the welding rod should be kept in the pool of molten metal. Starting and stopping of the operation should be as infrequent as possible. Welded seams can be hammered while hot (550–700 F.) to increase their strength.

BUCKLING AND CRACKING

Distortion or cracking must be guarded against, since there is a considerable contractive force set up by the shrinkage of the weld metal. Cracking is not usually encountered with small castings, thin edges of large castings, short welds on plate, or with free structural members. Preheating is necessary in the case of large castings or other parts having heavy sections, particularly where welds must be made in central areas. By preheating to 600–750 F., welding is made easier and shrinkage cracking is minimized.



Butt welds are best. Arrangement of the joint before welding varies with thickness of sheet

WELD CLEANING

Gas welds must be cleaned as soon as the metal has cooled to a handling temperature. Flux must be removed thoroughly under hot running water, using a wire or stiff bristle brush. The welded part should then be immersed for two or three minutes in a chrome-pickle solution, preferably hot, after which it should be rinsed in cold and hot water and carefully dried. This treatment should be repeated where the weld surface is subsequently filed or ground off. Further protection of welds is obtained by greasing with heavy oil, paraffin or lanolin, or by applying a protective paint for which the chrome-pickle treatment provides a good base.

RESISTANCE WELDING

Resistance welding of magnesium offers advantages of speed, economy and freedom from corrosion possibilities. It is not recommended, at present, for heavily stressed joints. Spot welding equipment must have accurate, synchronous electrical timing of power. In spot welding two magnesium surfaces together, it is possible to protect the contact surfaces with a chemical treatment, or with a joint sealer, but the outside surfaces and the electrodes must be brightened to decrease alloying of the magnesium with the copper electrode. The electrodes should be of hard, high-conductivity copper and should be water cooled. At least one of the electrode tips should have a conical or ball point so it will make a joint contact with the work. After welding the spots should be wire brushed and dichromated.

Electric seam welding can be used for joining sheets in the fabrication

of certain tanks and drums. The process is not applicable to joining flat sheets because of the attendant buckling. Welds may be of the continuous or intermittent type. Recommendations for spot welding also apply to seam welding of magnesium.

SOLDERING

Small surface defects in castings can be plugged by soldering. It is not recommended if the soldered area must withstand stresses. Soldering ordinarily is not used for joining.

The spot to be soldered first is brightened with a file, scratch brush or sandpaper, and should be roughened with a chisel or file to provide a mechanical bond with the magnesium surface. Preheat with a torch to 300–400 F., apply a small quantity of solder and, with a pointed iron, rub vigorously the interface between the molten solder and the magnesium. The solder should be kept molten and rubbing continued until the solder has alloyed with the magnesium. No flux is necessary. The solder should be applied only to the hole, not spread over the area surrounding the hole. After cooling, smooth the surface with a file and apply a protective paint. Only solders recommended for magnesium should be used.

SURFACE TREATMENT AND PAINTING

Magnesium alloys are stable under normal atmospheric conditions, but need protection in industrial or humid atmospheres, especially along the sea coast. Aqueous salt solutions and most acids corrode them. Inhibitive chemical treatments have been developed which serve as excellent bases for subsequent paint coats. Some of these treatments can be used alone for protection and decoration, but supplementary paint coatings are recommended. Primers and finishes available give good adhesion and protection. Approved chemical coatings and finishes effectively protect these alloys against salt air or occasional contact with salt water, and in a few cases will permit their use with normally corrosive chemicals.

CLEANING

Cleaning is the most important step in the chemical treatment of magnesium alloys. Without adequate cleaning the effectiveness of subsequent treatments is greatly reduced. Oil and grease may be removed by boiling in a strong alkaline cleaner or in a solution containing 3 oz. sodium carbonate, 2 oz. sodium hydroxide, 1 oz. soap and water to make 1 gal. This solution must be used at boiling temperature and the articles must be agitated in the hot bath until clean. They then must be washed in cold running water, followed by a dip in hot water to facilitate drying. Alternately, vapor degreasers or organic solvents can be used.

If *before* machining the part it is observed that dirt not removable by organic solvents or alkaline cleaners is present, or if surface oxidation is visible, treat as follows: Dip for 10 sec. at room temperature in solution containing by volume 8 parts concentrated nitric acid, 2 parts concentrated sulphuric acid and 90 parts water. Wash thoroughly in running water, then dip in hot water to facilitate drying. Use of this cleaner on machined surfaces is not advisable as the metal removed is likely to exceed dimensional tolerances.

A chrome-pickle treatment (Navy Aeronautical Spec. M-303) usually is applied to all castings and other forms. This treatment passivates and slightly etches the metal. Bare spots on reworked parts, as well as welds, can be protected with this treatment. It is a simple dip operation requiring 1½ to 2 min. in a bath containing 1.5 lb. sodium dichromate, 1.5 pt. concentrated nitric acid and water to make 1.0 gal. It is used at room temperature (70 to 90 F.). After the dip the parts are held above the tank for 5 sec. so the solution can drain off and so that a better colored coating will be obtained. Next, the parts are washed in running water and dipped in hot water. Fresh dip solutions produce the best finish.

A large user of magnesium parts has found it advisable to slush all parts, following each machining operation, with a commercial product containing specially prepared lanolin mixed with a solvent. As the solvent evaporates, a fine film of protective lanolin is deposited on the surfaces. This film is not "messy" and will resist corrosive agents for some time. Vapor degreasing after the final machining operation effectively removes the film.

A number of other treatments have been developed for use before and after machining. One of the most effective against salt water corrosion (Dow treatment No. 7 and AMC treatment G) effects no dimensional changes and normally is used after machining and before painting. This treatment, applied after proper cleaning, consists essentially of two steps. First, the parts are immersed for 5 min. in a water solution containing 15 to 20 per cent by weight of hydrofluoric acid (HF) at room temperature. Wash thoroughly in cold water. Next, boil parts for at least 45 min. in a water solution containing 10 per cent by weight of sodium dichromate. Rinse parts thoroughly in cold running water, then dip in hot water to facilitate drying.

CHEMICAL COLORING

Matte to bright silvery finishes are obtained by pickling in sulphuric, acetic or nitric acid; degree of luster being dependent on the alloy, the acid employed and the original smoothness of the metal surface. Attractive irridescent coatings in a range of shades and lusters are produced by the chrome-pickle treatment. Durability of these finishes can be improved by coating with a clear lacquer.

PRIMERS AND PAINTS

Most paint troubles have their start at the point of contact between the metal and the primer. Careful selection of a priming material is important, especially in regard to adhesion. An inhibitive character, best obtained with zinc chromate pigment, is essential for primers exposed to marine atmospheres.

Choice of finish coat materials largely is dependent on service conditions to be encountered. Almost any good quality oil paint, for instance, can be used over a good primer for indoor service if wear resistance is not needed. Full synthetic and oil-base synthetic enamels have been found satisfactory for general exterior work.

Much of the available data concerning the characteristics, applications and common methods of fabricating magnesium-base alloys has been summarized in this discussion. No attempt has been made to list all of the alloys available, those selected being typical alloys of wide application. Part of the data used has appeared in the Metals Handbook, 1939 edition, published by the American Society for Metals; in specifications published by the American Society for Testing-Materials; and in literature of companies which have cooperated in the preparation of this material. Reference sources consulted include Mark's Mechanical Engineers' Handbook, American Machinists' Handbook and Kent's Mechanical Engineers' Handbook.

Hole Circle Layouts—II

BY W. J. AND J. D. WOODWORTH

THE FOLLOWING TABLES, which are continued from those published previously (*AM*—Vol. 84, pages 257 and 259), are for accurate layout of holes on given circumferences. The values given are constants for a 1-in. circle. For larger or smaller circles, multiply the values by the diameter of the given circle. The tables are useful on precision machines.

A complete discussion on how to use the tables was given in the previous reference book sheet on this subject. Briefly, fasten the work in position and locate the true center. Move to the right a distance equal to the radius of the circle to be divided. Bore hole No. 1. Then move horizontally and vertically in turn, using the tabulated values for the given number of holes on the circumference; the end of each successive vertical movement locates a hole.

Hole No.	*Horizontal*	*Vertical*
Thirty-five holes:		
1	0.50000	.....
2	0.00803	0.08928
3,35	0.02385	0.08640
4,34	0.03890	0.08077
5,33	0.05268	0.07251
6,32	0.06480	0.06195
7,31	0.07481	0.04938
8,30	0.08242	0.03524
9,29	0.08740	0.01994
10,28	0.08954	0.00403
11,27	0.08883	0.01204
12,26	0.08525	0.02770
13,25	0.07894	0.04247
14,24	0.07008	0.05589
15,23	0.05898	0.06751
16,22	0.04598	0.07695
17,21	0.03149	0.08392
18,20	0.01600	0.08820
19	.....	0.08964
Thirty-six holes:		
1	0.50000	.....
2,19,20	0.00760	0.08682
3,18,21,36	0.02256	0.08419
4,17,22,35	0.03683	0.07899
5,16,23,34	0.04999	0.07139
6,15,24,33	0.06163	0.06163
7,14,25,32	0.07139	0.04999
8,13,26,31	0.07899	0.03683
9,12,27,30	0.08419	0.02256
10,11,28,29	0.08682	0.00760
Thirty-seven holes:		
1	0.50000	.....
2	0.00719	0.08450
3,37	0.02138	0.08207
4,36	0.03493	0.07727
5,35	0.04748	0.07027
6,34	0.05868	0.06122
7,33	0.06819	0.05043
8,32	0.07572	0.03818
9,31	0.08109	0.02484
10,30	0.08412	0.01077
11,29	0.08473	0.00360
12,28	0.08290	0.01787
13,27	0.07869	0.03162
14,26	0.07222	0.04446
15,25	0.06366	0.05604
16,24	0.05327	0.06597
17,23	0.04136	0.07404
18,22	0.02826	0.07996
19,21	0.01432	0.08359
20	.....	0.08480
Thirty-eight holes:		
1	0.50000	.....
2,20,21	0.00682	0.08230
3,19,22,38	0.02027	0.08005
4,18,23,37	0.03317	0.07562
5,17,24,36	0.04517	0.06913
6,16,25,35	0.05593	0.06076
7,15,26,34	0.06517	0.05072
8,14,27,33	0.07262	0.03931
9,13,28,32	0.07811	0.02681
10,12,29,31	0.08145	0.01358
11, 30	0.08258	.....
Thirty-nine holes:		
1	0.50000	.....
2	0.00648	0.08020
3,39	0.01925	0.07813
4,38	0.03154	0.07403
5,37	0.04301	0.06800
6,36	0.05336	0.06024
7,35	0.06233	0.05089
8,34	0.06969	0.04023
9,33	0.07523	0.02854
10,32	0.07884	0.01609
11,31	0.08041	0.00324
12,30	0.07987	0.00970
13,29	0.07729	0.02239
14,28	0.07270	0.03449
15,27	0.06622	0.04571
16,26	0.05803	0.05574
17,25	0.04835	0.06433
18,24	0.03738	0.07124
19,23	0.02548	0.07633
20,22	0.01291	0.07943
21	.....	0.08046
Forty holes:		
1	0.50000	.....
2,21,22	0.00616	0.07821
3,20,23,40	0.01831	0.07630
4,19,24,39	0.03003	0.07248
5,18,25,38	0.04099	0.06690
6,17,26,37	0.05096	0.05966
7,16,27,36	0.05966	0.05096
8,15,28,35	0.06690	0.04099
9,14,29,34	0.07248	0.03003
10,13,30,33	0.07630	0.01831
11,12,31,32	0.07821	0.00616
Forty-one holes:		
1	0.50000	.....
2	0.00586	0.07633
3,41	0.01744	0.07453
4,40	0.02862	0.07100
5,39	0.03912	0.06580
6,38	0.04870	0.05905
7,37	0.05715	0.05094
8,36	0.06425	0.04161
9,35	0.06985	0.03131
10,34	0.07382	0.02028
11,33	0.07603	0.00878
12,32	0.07650	0.00293
13,31	0.07515	0.01458
14,30	0.07204	0.02587
15,29	0.06725	0.03657
16,28	0.06088	0.04640
17,27	0.05308	0.05516
18,26	0.04404	0.06261
19,25	0.03397	0.06860
20,24	0.02310	0.07299
21,23	0.01168	0.07565
22	.....	0.07654
Forty-two holes:		
1	0.50000	.....
2,22,23	0.00558	0.07452
3,21,24,42	0.01663	0.07286
4,20,25,41	0.02730	0.06956
5,19,26,40	0.03737	0.06472
6,18,27,39	0.04660	0.05842
7,17,28,38	0.05478	0.05083
8,16,29,37	0.06174	0.04210
9,15,30,36	0.06734	0.03242
10,14,31,35	0.07140	0.02203
11,13,32,34	0.07390	0.01114
12, 33	0.07472	.....
Forty-three holes:		
1	0.50000	.....
2	0.00533	0.07280
3,43	0.01587	0.07125
4,42	0.02608	0.06818
5,41	0.03572	0.06365
6,40	0.04461	0.05778
7,39	0.05256	0.05066
8,38	0.05936	0.04247
9,37	0.06492	0.03338
10,36	0.06909	0.02357
11,35	0.07178	0.01326
12,34	0.07294	0.00267
13,33	0.07256	0.00799
14,32	0.07062	0.01846
15,31	0.06718	0.02855
16,30	0.06231	0.03803
17,29	0.05611	0.04669
18,28	0.04871	0.05436
19,27	0.04027	0.06088
20,26	0.03099	0.06610
21,25	0.02103	0.06990
22,24	0.01062	0.07221
23	.....	0.07300
Forty-four holes:		
1	0.50000	.....
2,23,24	0.00509	0.07116
3,22,25,44	0.01516	0.06970
4,21,26,43	0.02493	0.06685
5,20,27,42	0.03419	0.06261
6,19,28,41	0.04276	0.05711
7,18,29,40	0.05044	0.05044
8,17,30,39	0.05711	0.04276
9,16,31,38	0.06261	0.03419
10,15,32,37	0.06685	0.02493
11,14,33,36	0.06970	0.01516
12,13,34,35	0.07116	0.00509

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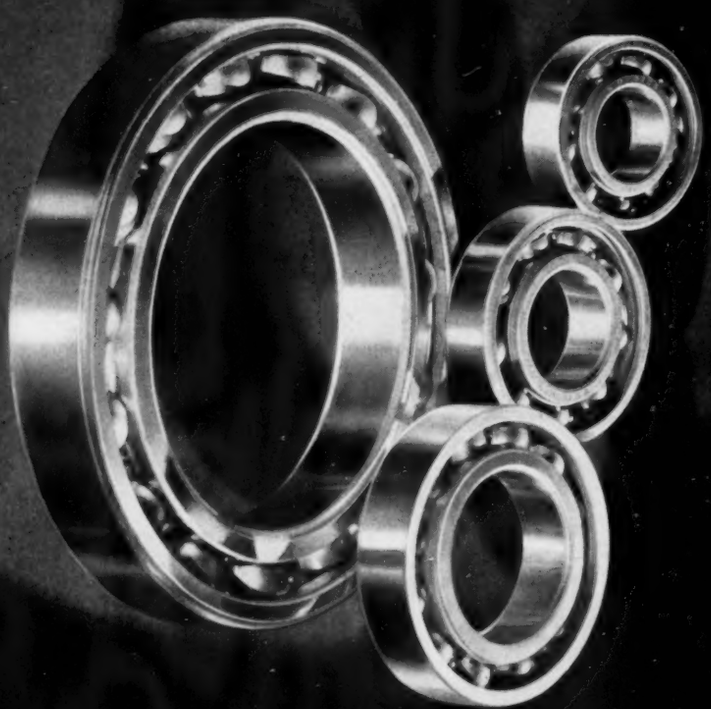

NEW DEPARTURE

THE FORGED STEEL BEARING

Hole Circle Layouts—II

Hole No.	Horizontal	Vertical
Forty-five holes:		
1	0.50000	.....
2	0.00487	0.06958
3,45	0.01450	0.06824
4,44	0.02386	0.06555
5,43	0.03275	0.06159
6,42	0.04100	0.05643
7,41	0.04846	0.05018
8,40	0.05497	0.04295
9,39	0.06041	0.03487
10,38	0.06467	0.02614
11,37	0.06769	0.01687
12,36	0.06937	0.00729
13,35	0.06971	0.00243
14,34	0.06870	0.01212
15,33	0.06634	0.02155
16,32	0.06270	0.03058
17,31	0.05783	0.03901
18,30	0.05184	0.04667
19,29	0.04484	0.05344
20,28	0.03696	0.05916
21,27	0.02837	0.06372
22,26	0.01923	0.06706
23,25	0.00971	0.06907
24	.....	0.06976
Forty-six holes:		
1	0.50000	.....
2,24,25	0.00465	0.06808
3,23,26,46	0.01389	0.06682
4,22,27,45	0.02285	0.06430
5,21,28,44	0.03140	0.06059
6,20,29,43	0.03935	0.05576
7,19,30,42	0.04658	0.04987
8,18,31,41	0.05294	0.04307
9,17,32,40	0.05831	0.03545
10,16,33,39	0.06259	0.02719
11,15,34,38	0.06571	0.01841
12,14,35,37	0.06761	0.00929
13, 36	0.06824	.....
Forty-seven holes:		
1	0.50000	.....
2	0.00446	0.06664
3,47	0.01331	0.06546
4,46	0.02191	0.06309
5,45	0.03012	0.05962
6,44	0.03780	0.05506
7,43	0.04480	0.04954
8,42	0.05101	0.04312
9,41	0.05630	0.03595
10,40	0.06059	0.02811
11,39	0.06379	0.01979
12,38	0.06586	0.01111
13,37	0.06675	0.00223
14,36	0.06646	0.00669
15,35	0.06498	0.01548
16,34	0.06233	0.02401
17,33	0.05857	0.03210
18,32	0.05377	0.03961
19,31	0.04801	0.04644
20,30	0.04140	0.05242
21,29	0.03404	0.05747
22,28	0.02607	0.06149
23,27	0.01765	0.06442
24,26	0.00890	0.06619
25	.....	0.06680
Forty-eight holes:		
1	0.50000	.....
2,25,26	0.00428	0.06526
3,24,27,48	0.01276	0.06415
4,23,28,47	0.02102	0.06193
5,22,29,46	0.02893	0.05866
6,21,30,45	0.03634	0.05438
7,20,31,44	0.04312	0.04917
8,19,32,43	0.04917	0.04312
9,18,33,42	0.05438	0.03634
10,17,34,41	0.05866	0.02893
11,16,35,40	0.06193	0.02102
12,15,36,39	0.06415	0.01276
13,14,37,38	0.06526	0.00428
Forty-nine holes:		
1	0.50000	.....
2	0.00411	0.06394
3,49	0.01224	0.06289
4,48	0.02019	0.06080
5,47	0.02780	0.05773
6,46	0.03495	0.05369
7,45	0.04153	0.04878
8,44	0.04744	0.04308
9,43	0.05255	0.03666
10,42	0.05680	0.02964
11,41	0.06013	0.02212
12,40	0.06247	0.01426
13,39	0.06377	0.00615
14,38	0.06403	0.00205
15,37	0.06325	0.01023
16,36	0.06142	0.01823
17,35	0.05859	0.02593
18,34	0.05479	0.03322
19,33	0.05009	0.03994
20,32	0.04457	0.04602
21,31	0.03832	0.05136
22,30	0.03145	0.05582
23,29	0.02404	0.05939
24,28	0.01625	0.06197
25,27	0.00819	0.06354
26	.....	0.06408
Fifty holes:		
1	0.50000	.....
2,26,27	0.00395	0.06266
3,25,28,50	0.01176	0.06168
4,24,29,49	0.01940	0.05972
5,23,30,48	0.02674	0.05681
6,22,31,47	0.03364	0.05302
7,21,32,46	0.04003	0.04838
8,20,33,45	0.04577	0.04298
9,19,34,44	0.05080	0.03691
10,18,35,43	0.05502	0.03025
11,17,36,42	0.05838	0.02312
12,16,37,41	0.06082	0.01561
13,15,38,40	0.06230	0.00787
14, 39	0.06278	.....
Fifty-one holes:		
1	0.50000	.....
2	0.00379	0.06144
3,51	0.01131	0.06051
4,50	0.01867	0.05867
5,49	0.02573	0.05592
6,48	0.03240	0.05235
7,47	0.03859	0.04796
8,46	0.04420	0.04285
9,45	0.04913	0.03710
10,44	0.05331	0.03078
11,43	0.05669	0.02399
12,42	0.05922	0.01685
13,41	0.06083	0.00944
14,40	0.06153	0.00190
15,39	0.06130	0.00568
16,38	0.06013	0.01317
17,37	0.05806	0.02046
18,36	0.05511	0.02744
19,35	0.05132	0.03400
20,34	0.04675	0.04006
21,33	0.04147	0.04549
22,32	0.03557	0.05025
23,31	0.02912	0.05423
24,30	0.02224	0.05741
25,29	0.01501	0.05970
26,28	0.00757	0.06109
27	.....	0.06156
Fifty-two holes:		
1	0.50000	.....
2,27,28	0.00365	0.06027
3,26,29,52	0.01089	0.05939
4,25,30,51	0.01796	0.05764
5,24,31,50	0.02477	0.05506
6,23,32,49	0.03124	0.05167
7,22,33,48	0.03724	0.04753
8,21,34,47	0.04269	0.04269
9,20,35,46	0.04753	0.03724
10,19,36,45	0.05167	0.03124
11,18,37,44	0.05506	0.02477
12,17,38,43	0.05764	0.01796
13,16,39,42	0.05939	0.01089
14,15,40,41	0.06027	0.00365
Fifty-three holes:		
1	0.50000	.....
2	0.00351	0.05913
3,53	0.01048	0.05831
4,52	0.01730	0.05666
5,51	0.02388	0.05421
6,50	0.03013	0.05101
7,49	0.03595	0.04709
8,48	0.04126	0.04251
9,47	0.04600	0.03732
10,46	0.05010	0.03162
11,45	0.05348	0.02548
12,44	0.05612	0.01897
13,43	0.05796	0.01221
14,42	0.05901	0.00526
15,41	0.05922	0.00176
16,40	0.05859	0.00874
17,39	0.05714	0.01562
18,38	0.05490	0.02227
19,37	0.05188	0.02859
20,36	0.04813	0.03453
21,35	0.04371	0.03999
22,34	0.03868	0.04488
23,33	0.03309	0.04914
24,32	0.02705	0.05270
25,31	0.02063	0.05553
26,30	0.01391	0.05758
27,29	0.00701	0.05883
28	.....	0.05924
Fifty-four holes:		
1	0.50000	.....
2,28,29	0.00338	0.05804
3,27,30,54	0.01010	0.05726
4,26,31,53	0.01668	0.05571
5,25,32,52	0.02303	0.05339
6,24,33,51	0.02907	0.05035
7,23,34,50	0.03472	0.04664
8,22,35,49	0.03990	0.04229
9,21,36,48	0.04454	0.03738
10,20,37,47	0.04858	0.03195
11,19,38,46	0.05196	0.02610
12,18,39,45	0.05464	0.01988
13,17,40,44	0.05658	0.01341
14,16,41,43	0.05775	0.00675
15, 42	0.05814	.....

DRILLS *plus* BRAINS *produce* PROFITS

Once this operation required two drills and two jigs—twice the expense, twice the time. Not now, though. A G. T. D. Greenfield engineer suggested a special step-drill and as a result, a certain plant foreman is congratulating himself on a substantial cost reduction.

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AMERICAN MACHINIST

Tip From a Politician

THE OTHER DAY in Washington a prominent Congressman unburdened himself to a small luncheon group.

"When you return home I wish you would give this message to the men in your industry," he said. "Tell them they may be doing a fine job as manufacturers, but they are neglecting one of the most important branches of their business—politics.

"Whenever any measure comes up affecting labor, we hear promptly from unions. Bill Green has the best lobby in Washington. But where is industry when legislation arises? It seems speechless, unorganized and totally uninterested in putting its ideas before Congress. It had better get busy."

Such blunt advice from a practical politician led to inquiries on the Hill and to uncovering some pertinent facts.

Many Senators and Congressmen receive more letters from crackpots back home than from business men. Half the time when an industrialist writes, he says "Support the XYZ bill" without stating reasons why the bill deserves support.

Said one Congressman, "You can bet that if I vote against unions on a controversial issue, every union man will be at the polls next election day to knife me. Businessmen, on the other hand, are just as likely on election day to play golf or go fishing as to vote."

Sending notes of protest as the result of an accomplished fact does little good. Britain and France have found that out. The time to act is before anything important happens. That is why it is imperative that trade associations, other groups of business men, and especially individual industrialists inform Congress where they stand on pending legislation.

An ill-considered, name-calling blast will be harmful. But, as an old hand on the Hill advises, "A well thought out statement, temperate in tone and marshalling the main facts for or against a specific bill, carries weight."

There is another reason why industrialists should become articulate on legislative matters. So many bills are introduced in Congress that it is physically impossible for every Senator and Congressman to acquaint himself with their provisions. He appreciates having the arguments assembled and presented to him.

Unions lose no opportunity to recite forcefully their arguments. Nor do many other special interests. Why not business men?

What happens when only one team shows up for a scheduled debate? Every high school boy knows that the other team loses by default. That is what happens often in legislation affecting business. Be sure your team shows up with plenty of arguments before your Congressmen have to make a decision.

Burnham Finney

GAGING BUSINESS

Employment and payrolls touch new high. Machine tool orders continue in unprecedented volume. Aircraft and shipbuilding facilities hard pushed. Railroad equipment business meager

Employment and payrolls in many branches of the metal-working industry are of record proportions. Indications are that they will stay at such heights in the weeks immediately ahead.

Machine Tools—Business continues to pour into machine tool builders at an unprecedented rate. Foreign orders and contracts for the aircraft industry and for national defense purposes predominate. Volume of bookings from normal domestic sources, however, is widening. Automobile makers, farm implement companies, railroads and electrical manufacturers have been purchasing machine tools in sizable numbers. Bookings have been well distributed geographically and well diversified as to industries. Recent postponements of aircraft tooling programs have been confusing and annoying to machine tool builders who, in many cases, had reserved considerable plant capacity for rush aircraft orders. This situation is now in the process of being cleared up. Some machine tool companies are adding modestly to plant capacities and are taking other means to enlarge their output. Never in the history of the industry has so much work been farmed out in an effort to squeeze out more production.

Aircraft—Planes and engines valued at $200,000,000 have just been ordered by the Allies. It is believed that these new purchases raise to about 7,000 the number of planes bought by the British and French since the outbreak of war. The contracts are with Wright and Allison for engines, and with Curtiss-Wright, Bell and Douglas for planes. It is reported that some of the plane business is likely to be farmed out to other companies. The Allies have agreed to pay the tooling cost necessary for development of still newer types of planes in return for the privilege of being able to secure the latest types of planes now in production. In the Detroit district several million dollars worth of aircraft parts business has been turned down by companies unwilling to expand further their plant capacities.

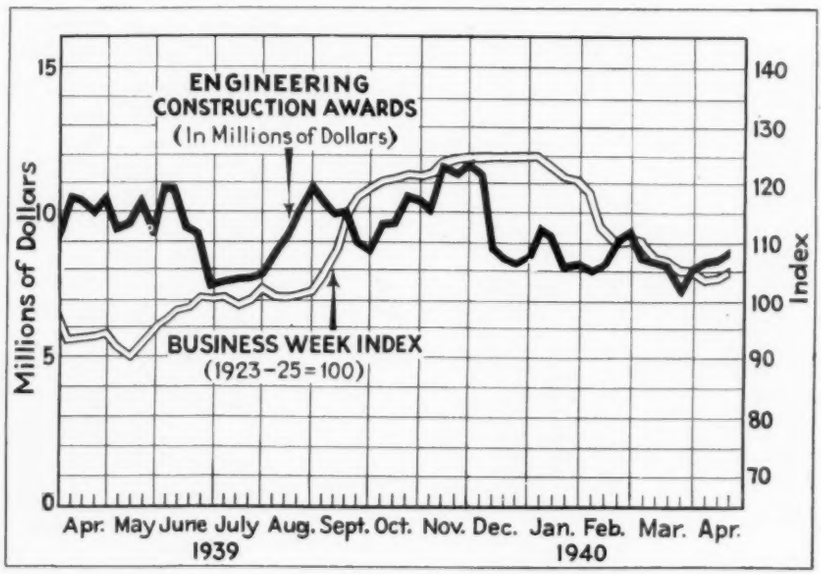
Steel—The cut in flat-rolled steel prices, which prevailed for a short time, did not drive in much tonnage to the mills. The decline did not apply to export orders which in some items have been ranging from 20 to 25 per cent of total bookings. Foreign demand is expected to continue and perhaps grow as the war is intensified. Steel operations remain in the neighborhood of 60 per cent.

Railroad Equipment—Orders and inquiries are scarce. Car builders still are fairly well occupied on contracts made last fall, though the Mount Vernon Car Mfg. Co. has been plagued with strikes since February. Canadian National has bought 150 freight cars, 25 baggage cars and five mail cars from Canadian Car & Foundry Co. The Rock Island has been granted court authority to purchase 150 freight cars from Pullman and 60 from American Transportation Corp. Kansas City Southern plans to issue certificates to finance the buying of 11 passenger cars and four diesel electric locomotives, one of which is a switcher. Pending inquiries include 1,250 cars for the Gulf, Mobile & Northern, 500 light-weight freight cars for the Denver & Rio Grande, 75 hopper cars for the Cincinnati, New Orleans & Texas Pacific, and 50 cars for the Panama Railroad Co. Class I railroads put into service in the first quarter 20,253 new or rebuilt freight cars, 63 electric and oil-electric locomotives and 16 steam locomotives.

Farm Equipment—If farm prices stay where they are, farm equipment sales promise to be better than in 1939. Several tractor makers continue to operate on good schedules, some plants running two and three shifts. Threatened strikes in at least two factories have thus far been avoided by negotiations.

Shipbuilding—Private shipbuilding companies and navy yards are at an all-time peak, with all available ways in use. The new expanded Navy program is expected to crowd operations even more. The Maritime Commission has awarded three cargo vessels to Bethlehem Steel for delivery to the Mississippi Shipping Co., New Orleans. Matson Navigation Co. has ordered four ships of the C-3 type, this being the first new construction for intercoastal trade in ten years.

Electrical Equipment—Makers of turbines, generators and other large electrical units are booked months ahead at capacity. Small motor production is reported very active. Household appliance output is brisk.



War Spurs Passage of U. S. Defense Bills

Navy gets almost billion dollars for '41, a new all-time high. Secret building of warships by Japan stressed by government as reason for expanding Navy. War Department to receive its share

WASHINGTON—As Congress nears completion of its national defense program for 1941, the Scandinavian war and new talk of Japanese seizures in the Pacific are bringing demands for last-minute additions of funds and authorizations.

The defense program consists of five bills. Navy has three: (1) the regular supply bill for 1941; (2) a bill authorizing the increase of the basic naval establishment; and (3) a bill to consolidate naval construction bureaus for efficiency. Army has two: (1) the regular supply appropriation for 1941; and (2) the non-military functions of the Army. Only the Navy supply bill had passed as this was written but all had made progress. There is no Army expansion bill this year.

By a vote of 63 to 4, the Senate passed the House-approved 1941 Naval appropriation of $963,797,478. This is $123,514,099 less than requested by the Administration, but is $48,437,229 more than the 1940 fund and is a new all-time high. Of interest to the metal-working industry are funds provided for starting two 45,000-ton battleships, two cruisers, one aircraft carrier, eight destroyers, six submarines and five auxiliary vessels. Also provided are funds for completion in the next four years of four cruisers, seven destroyers and seven submarines; and for purchase of 471 airplanes. For airplanes, $41,000,000 is set aside, including $20,000,000 for contracts made this year.

In 1938 Congress passed a law which increased the Navy's total strength by 20 per cent, to cost about $1,000,000,000. This year the Navy asks for further expansion of 25 per cent. The House passed the bill, cutting the proposed increase to 11 per cent. The Senate is now debating it and is under Administration pressure to raise the 11 per cent. Secret construction by Japan is the chief argument; aid to Allied navies is scarcely whispered. The 11 per cent expansion would cost about $655,000,000 and would provide for construction over a four-year period of 63 ships: cruisers, aircraft carriers, destroyers, submarines,—a total of 167,000 tons. In addition, 154,000 replacement tons already authorized but not built would be included in the four-year program.

The War Department's 1941 appropriation has been passed by the House and hearings on it by the Senate Appropriations Committee are to be completed soon. It provides $61,000,000 for anti-aircraft artillery, rifles, anti-tank guns, tanks, and light and heavy artillery; $12,000,000 for seacoast defense, fixed and mobile weapons; $18,500,000 for motors, augmentation and replacement; $2,260,000 for harbor defense and airplane crash boats; $9,700,000 for airplanes.

The House was little affected by foreign wars as it acted on this bill. To emphasize its attitude, it actually trimmed $68,357,000 off the President's budget estimate. The cut wiped out a $13,000,000 low-temperature experimental airbase proposed for Alaska; transferred all but $2,000,000 of the $14,500,000 educational orders fund for 1941 over into the general war supplies fund; and reduced the Air Corps airplane replacement program from 496 to 57 planes. The cut in airplanes would not affect the 5500 quota to be attained by June 30, 1941.

The War Department's civil functions appropriation for next year is nearly all for construction work, including enlargement of the capacity of the Panama Canal.

ARMY ORDERS BROWNING GUNS

WASHINGTON—Browning machine guns and related items valued at $726,004 will be made by Saginaw Steering Gear Div. of General Motors under an educational order award by the War Department. Mergenthaler Linotype Co. and Eastman Kodak will make aiming circles and related items costing $128,953 and $104,411 respectively. Tuthill Pump Co., Chicago, and Measuregraph Co., St. Louis, have received small educational orders for gunners' quadrants.

ADVANCED PLANES FOR EXPORT

WASHINGTON—The War Department has released for export the B-24 Consolidated bomber, a four-motored plane with cruising radius of over 3,000 miles and speed greater than 300 M.P.H. Eight other late types of planes also are now available to the British and French: the P-38, A Lockheed two-motored interceptor; P-39, the Bell Aircobra; P-40, a Curtiss fighter; P-40D, an improved type of the P-40; a Lockheed-Hudson light bomber; Bell Aircuda, a two-engined multiplace fighter; a light Douglas attack bomber; and a light Martin attack bomber.

British Combine

Royal Welcome—*Hints that Germany will soon redouble her undersea warfare against Allied and neutral shipping have brought about a speed-up in British plants making depth charges, most potent weapon against submarines. Here girls weld drums which will contain about 500 lb. of TNT*

No Opposition to Technical Progress By Industry or Labor at TNEC Hearings

Although machines may replace workers, evidence shows that mechanization has not caused a net reduction in employed men

BY ROBERT COLBORN

WASHINGTON — The technology hearings of the Temporary National Economic Committee are doubtless educational to members of the committee, but as a scientific effort to develop facts about the impact of technical progress on our economy they are proving pretty much of a frost. Some of the foremost industrialists and labor leaders of the country have come to the stand, been questioned by professional economists, and the result has been a set of personal opinions buttressed by appeals to published and well-known statistics. There is no answer here to the effect of the machine.

The hearings do, however, represent a unique survey of responsible opinion on the subject. No witness expressed opposition to technical progress or even any desire to slow it up. No evidence was presented that, even within the confines of one industry, technical progress has effected a net reduction in the number of men employed, though Philip Murray of SWOC contended that only marked reduction in hours has prevented such a result in the steel industry. From industrialists' testimony that technology eliminates the unskilled, and unionists' testimony that it eliminates the skilled, it may be concluded that technical progress emphasizes the role of the semi-skilled worker. All witnesses except Edsel Ford agreed, and the labor witnesses emphasized, that a great many individual workers are displaced by machines, that there are often no jobs for these particular workers, and that providing for them is the most immediate problem posed by technology.

Ford Outlines Changes

But no such group of men as TNEC assembled could answer questions for a day or half day each without saying interesting things. Some highlights:

Edsel Ford: Payroll and purchases for each Model T produced—with 5,000 parts—was $454.42; for the Model A, with 6,000 parts, $526.84; for the V-8, with 16,000 parts, $683.23. . . . There is now less hand labor and less unskilled and more semi-skilled; the fit and technique is becoming more complicated. . . . Ten per cent of Ford's direct labor is tool and die men. . . . It has been difficult the last year or two to get toolmakers. This is due to style changes, on which Ford spends $5,000,000 a year. . . . Ford's new capital investment during 1939 was $36,000,000. Expansion and replacement during the past six years cost $169,152,000; equipment costing $96,682,000 was disposed of. . . . Ford believes there has been no technological displacement of auto workers; all are absorbed. . . . Steering post gear-shift involves 40 parts against 2 formerly. . . . Ford is now running at three-quarters of capacity. . . . Original impetus for Ford rural plants near Dearborn was "to show an example of how a small stream could be developed hydro-electrically" and the Rouge was chosen. "We have found that our costs have been less than at the main plant."

Labor Gives Its Views

R. J. Thomas of UAW: Man-hour productivity in auto industry in 1938 was 112 per cent of that in 1929. . . . "Only where union organization is strong may workers secure any share of benefits of technology.". . . In the Ford plant 43 per cent of the workers require one day to learn their jobs, 36 per cent up to eight days, 6 per cent up to two weeks, 14 per cent from a month to a year, and only one per cent more than a year. "This information comes from our people in the Ford plant" . . . UAW has contracts covering 400,000 men . . . Union activities have reduced productivity 5 to 10 per cent by eliminating speed-up. The union is not opposed to technological improvements. . . . Only major change expected soon in autos is plastic bodies, already tried in Europe, which are expected within ten years. . . . "In the automobile industry the tendency is more towards lower skilled occupations all the time."

Steel Has Its Innings

Charles R. Hook, American Rolling Mill Co: Twenty-seven continuous sheet rolling mills had been introduced by 1937 at a cost of $500,000,000. . . . Total employment in steel industry increased from 427,000 in 1927 to 544,000 in 1937. . . . Light flat rolled products increased from 6,327,000 tons in 1926 to 10,793,000 in 1937. Average price dropped 31.1 per cent from 1926 to 1939. . . . The new process amounts to introduction of an entirely new product. . . . Introduction of continuous mills at Armco's Middletown plant reduced man-hours per ton from 32.5 in 1926 to 19.1 in 1937 or 41.2 per cent. Same time production increased 82.4 per cent, employment 32 per cent, and hourly payroll 41.2 per cent. . . . Continuous mill has increased skill required. Common laborer today is almost eliminated. . . . Annual earnings of Armco wage-earners rose from $1,685 in 1926 to $1,893 in 1939. . . . Installation of the continuous mills cost Armco $20,492,778 between 1927 and 1937. . . . Percentage of Armco workers over 40 was 30 per cent in 1929 and in 1939.

Labor Displaced, Says Murray

Philip Murray, SWOC: The SWOC conducts a continuous educational campaign among its members in favor of technological improvements. . . . On the continuous mills 126 men produce the same tonnage as 4,512 men on hand mills. . . . Five hundred men were laid off 10 days ago (April 2) through closing of Republic Steel's Massillon hand mills . . . 38,470 men have already been displaced by strip mills—more than 50 per cent in 1937 and 1938. . . . In one case 3,000 men were laid off at once. . . . In the 50,000-pop. town of New Castle, Pa., 5,700 workers have been displaced, 4,500 from the hand mills and 1,200 Bessemer steel workers. . . . Payrolls per ton of steel produced have declined 10 per cent since 1923; labor cost now is the same as in 1929 because of rising wages. . . . The 27 per cent rise in wage rates from 1936 to 1939 has resulted in no increase in total wages per ton. . . . The new steel technology is not creating new jobs elsewhere. . . .

PLANE MAKERS ADOPT STANDARDS

SAN FRANCISCO—Plane manufacturers on the West Coast are cooperating to standardize basic aircraft materials. The group will be known as the Western Aircraft Standards Committee and will undertake standardization of such parts as cable-end bearings, ventilating ducts, universal joints, screws and steel tubing sections. The committee also will undertake standardizing dimensions and specifications for stainless steel sheets and plates.

Edward J. Kasnicka, Lockheed Aircraft Corp., is chairman of the committee. Every effort will be made to standardize tools, as well as materials, thereby simplifying repairs, eliminating confusion in manufacture and assembly of aircraft, and reducing costs.

A similar Standards Committee is functioning in the East, but its activities as yet have not been made public. However, it is cooperating with the west coast committee.

INSIDE DETROIT

Motor car production in May will stay near April's total of 465,000 units. Output is 25 per cent higher and much better stabilized than in 1939. Foreign sales badly affected by war

BY RUPERT LE GRAND, DETROIT EDITOR

DETROIT—April production of cars and trucks, U. S. and Canada, approximated an earlier estimate of 465,000 units. Informed trade sources believe that the current level of operations will be maintained within close limits during May, and that no real tapering off of assemblies is likely to occur before June.

No new production record was established in April, but the month did outstrip the similar 30 days in 1939 by 110,000 units, or 31 per cent. Furthermore, April served to swell the total for the first four months to 1,776,000 cars and trucks, or 25 per cent more than were built in the similar period a year ago.

Remarkable Stability

A striking aspect of factory operations since the turn of the year is their relative stability from month to month. The swings either side of an arithmetric average for the four-month period are less than they were in 1939. According to the table, February of last year fell 10.5 per cent below the average, but in March of that year output was stepped up 10 per cent above the average. This year, February was down only 5 per cent from the average, March closely coincided with the average, and operations in April were only 4.7 per cent above the average.

	Production	Deviation from Average
1939		
Jan.	356,950	+0.68%
Feb.	317,517	−10.5 %
Mar.	389,489	+10.0 %
Apr.	354,263	
Total	1,418,219	
Average	354,544	
1940		
Jan.	449,314	+1.2 %
Feb.	421,820	−5.0 %
Mar.	439,111	−0.92%
Apr.	465,000*	+4.7 %
Total	1,776,041	
Average	444,013	

* Estimated.

The narrowed fluctuation in monthly production during 1940 may be attributed to several causes: (1) factory sales organizations have largely overcome the reluctance of the public to buy in the winter months, (2) this situation leads to more accurate forecasting of assemblies, (3) it is believed that a certain amount of artificial control of production has been placed in effect this year, to maintain public confidence despite the downturn that occurred in industrial production, and to keep labor satisfied by maintaining full pay envelopes.

Exports Drop But Outlook Is Good

It is unusual to see operations maintained at such a constant level despite anticipation of and participation in a spring bulge in sales. Normally a compensating rise in output is made. But the actual situation created by a stabilized output is that the Federal Reserve Board's index of automobile production, when adjusted to seasonal influences, is falling.

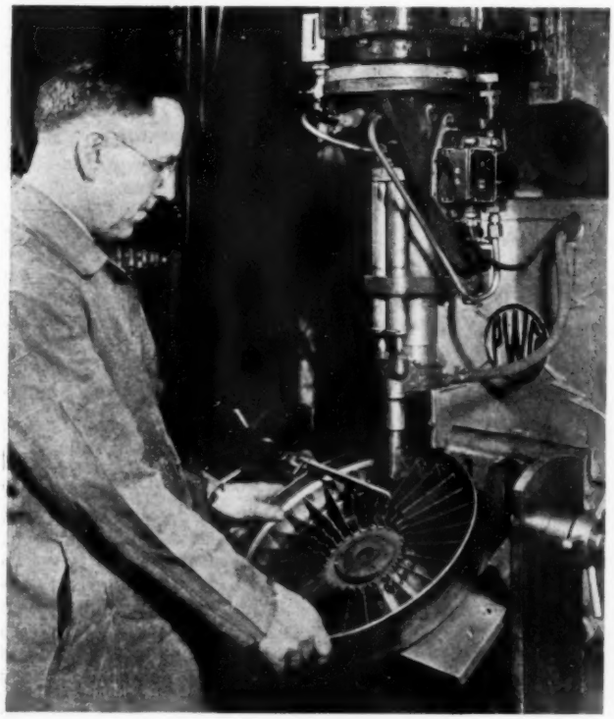
Despite this statistical phenomenon there is confidence in automobile circles that the domestic situation is unclouded, and that following a good windup of 1940 models, the public will strongly react to the new models to be unveiled next fall. The foreign picture is proving the chief cause of worry. Factory sales abroad from U. S. plants fell to 76,427 units in the first three months this year, as compared with 100,839 cars and trucks in the same months of 1939. The loss has been felt mainly in passenger cars.

In the first three months of 1939, one out of thirteen cars produced in U. S. plants, and one out of five trucks found their way to customers abroad. That picture has been abruptly changed by unsettled conditions in foreign markets. During the first three months of 1940, one domestically produced passenger car out of 28 was transported beyond the confines of the United States. The percentage of trucks sold abroad is little changed.

Actual exports of passenger cars during the first three months of 1940 were 37,637 units, compared with 58,895 a year ago. Had world conditions permitted the export of cars this year in the same ratio of gain as experienced in the domestic market, the figure would have been approximately double the actual one.

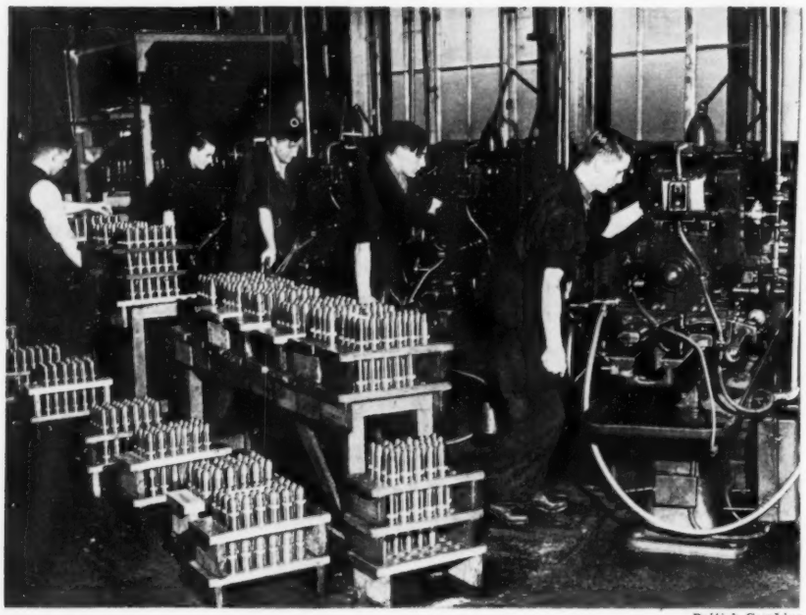
SALES OUTLOOK GOOD

DETROIT—Immediate outlook for domestic motor car sales is stable, despite spottiness experienced by some independents and high-priced lines. But their volume is insufficient to swing the situation, and some erratic sales reports are due to periodic campaigns. Chevrolet's recent success is a more accurate barometer; about 68,000 cars were sold the first twenty days of April, only 60,658 the same period of March. Volume shot at for April is 120,000; March's was 106,000.



Simple

Simplicity is combined with strength in the impeller and runner of the Chrysler fluid drive. Here stamped fins are being spot welded to form a runner subassembly. Final assembly is arc welded to make a leak-proof housing



British Combine

The Irish, Too—*There will be no Allied shortage of shells during the war if Ireland's efforts have anything to do with it. Here automatic lathes are being pressed into service turning out bodies and noses for anti-tank shells. The factory is located somewhere in Northern Ireland*

Canada Expects $60,000,000 Orders; Moves to Divert Business from U. S.

OTTAWA—One of the first acts of the new Canadian Ministry of Munitions and Supplies has been to take steps to increase the amount of British and French orders of this kind coming to Canada. Orders totaling $60,000,000 are expected soon, of which $35,000,000 will be for aircraft. To this end, John Carswell, former president of the Burlington Steel Co., has been named Canadian liaison officer for the Allied purchasing board in New York. It will be his duty to keep the board informed of what orders Canada can fill as satisfactorily as can the United States. He will also keep the Canadian Ministry informed of changes of trends of purchasing, so that Dominion industry can be geared to meet demands in advance of contract.

This move to swing more Allied war business to Canada is part of the series of rapid changes being made by the new department to which members of the old war purchasing board are giving closer cooperation. The department proposes extending its work into the whole field of Canadian industry.

Second-line industry will be aided to gear itself for production. The Ministry may even purchase machinery necessary to equip some of the second-line factories and lease it to them at a rental sufficient to amortize its cost in a few years.

The board's experts will survey the whole set-up of Canadian industry and will recommend establishment of new plants where necessary to meet war demands not now being fulfilled here. It is expected that this will divert a good deal of business from the United States to Canada.

Transport Minister Howe, who has taken the additional portfolio of Munitions and Supplies, has announced that the organization of the new department is nearly completed. Leslie R. Thompson, formerly associate assistant of the old supply board has been named controller and secretary of the department.

S.A.E. MEETS IN HARTFORD

NEW YORK—Ralph Flanders, president of Jones & Lamson Machine Co., will be the principal speaker at the National Production Meeting of the Society of Automotive Engineers when it meets in Hartford, Conn., May 7 and 8. He will discuss "Industry and the Job Problem." H. L. Moir, the Pure Oil Co., and Prof. O. W. Boston, University of Michigan, will reveal results of a new study of cutting fluid recommendations. L. S. Martz, Micromatic Hone Corp., will give data on producing specified finishes by honing. Control of surface finish in machine-shop practice will be discussed by R. F. Gagg, Wright Aeronautical Corp. E. L. Hemingway, Foster Machine Co., will present a paper on a new method of testing and grading fine abrasives.

Tonnage Shortage Seen by Shipbuilders Association

NEW YORK—A world-wide tonnage shortage at the end of the present war is anticipated, according to H. Gerrish Smith, president of the National Council of American Shipbuilders. Mr. Smith says that the United States is fortunate in having started an extensive ship replacement program before the war began.

At the end of 1939 approximately 506,000 displacement tons of government vessels, and approximately 1,120,000 gross tons of sea-going commercial vessels were under construction in the United States. An additional number of smaller craft, barges, ferries and tugs were being built on the lakes, rivers and seacoasts.

The estimated cost of the 141 ships comprising the Maritime Commission program at the close of 1939 was $366,000,000, of which private shipyards were expending $185,000,000, or nearly 50 per cent, with other industries for materials and equipment. Approximately $148,000,000 for shipyard labor was being expended on the Atlantic, Gulf and Pacific Coasts.

Metal-Workers Offered Prizes By Lincoln for Welding Papers

CLEVELAND—The James F. Lincoln Arc Welding Foundation's industrial progress program offers a number of awards of special interest to readers of AMERICAN MACHINIST. The awards are for reports describing advances and improvements made between now and June 1, 1942, by application of arc welding to industrial work, including design, manufacture, fabrication, construction, welding service and maintenance. There will be four awards of $150, $250, $500 and $700 for each of 20 machinery divisions, as well as eight other awards amounting to $13,600 for the best papers in these divisions, which include metal-cutting, metal-forming, jigs and fixtures, and others. Twelve additional awards will be made for the best studies of plants and/or equipment maintenance, including machinery and mechanical equipment, as well as structural maintenance. All papers in these groups are eligible for main awards amounting to $5,000, $7,500 and $10,000.

ROY PORTER CELEBRATES

CHICAGO—Roy Porter, president of Marshall Huschart Machinery Co., will celebrate on May 5 fifty years affiliation with the machine tool industry. A dinner party will be given at the Lake Shore Athletic Club to which machine tool manufacturers represented by Mr. Porter's company will be invited.

General Motors and C.I.O. Expected to Sign New Contract Without Much Delay

Plant Managements already benefiting from dealing with only one union committee. C.I.O. starts drive to win all plants

DETROIT—Negotiations for a new contract between General Motors and the UAW-CIO got under way last week under auspicious circumstances after the General Motors plant elections were completed. Post-election utterances by union officials and a statement by President R. J. Thomas of the union immediately prior to discussions with G. M. executives indicated a desire to reach a speedy and amicable settlement.

First thing to be done was to dispose of grievances unsettled under the old contract. If they should be cleared away satisfactorily, it appears that the negotiators will get down to cases with respect to a wage increase, an improved grievance procedure, and seniority.

By winning 48 out of 59 plants in which elections were held, the UAW-CIO must assume direct responsibility for the success or failure of collective bargaining for the majority of G.M. production workers. It is reported that plant managements already are benefiting from having to deal with only one committee rather than dual or divided union committees.

The UAW-AFL won five plants in the elections, but will represent only 5,600 workers, although it polled 25,911 votes. The UAW-CIO polled 84,204 votes or 68 per cent of the total. One plant was won by the Mechanics Educational Society. Three plants will require run-off elections because no union secured a majority of votes.

Apart from the contract negotiations with General Motors is the new effort of the UAW-CIO to displace the UAW-AFL in the five plants won by the latter and to organize several others. Elections also have been requested in five more G.M. plants.

N.M.T.A. OFFICERS NOMINATED

CHICAGO—The 42d annual convention of the National Metal Trades Association will be held at the Biltmore Hotel, New York, May 21-22. Officers for the coming year have been nominated and include A. H. Timmerman, Wagner Electric Corp., for president; Roe S. Clark, Package Machinery Co., for first vice-president; H. H. Kerr, Boston Gear Works, Inc., for second vice-president and treasurer. The Honorable Raymond E. Baldwin, Governor of Connecticut, will address the annual banquet on Tuesday evening, May 21.

Nomination for councilors for two years include: Ralph H. Illingworth, Boston Machine Works Co.; D. P. Sommer, Keystone Steel & Wire Co.; Arthur E. Blackwood, Norton, Lasier Co.; George A. Seyler, The Lunkenheimer Co.; T. H. Doan, The Foote-Burt Co.; R. W. Gillispie, The Jeffrey Mfg. Co.; S. Owen Livingston, Gallmeyer & Livingston Co.; A. E. Newton, The Collins Co.; N. R. Knox, Bucyrus-Erie Co.; R. G. Wilson, The Challenge Machinery Co.; J. L. Kopf, Jabez Burns & Sons, Inc.; Ernest Dunford, Landis Machine Co.; D. Norris Benedict, Frick Co.; N. W. Pickering, Farrel-Birmingham Co., Inc.; W. F. Newhouse, Saranac Machine Co.

GROB BROTHERS TO SPONSOR SHOW

CLEVELAND—A Production and Machine Tool Show will be held in the public auditorium of this city from June 25 to 29 under the sponsorship of Grob Brothers of Grafton, Wis. Richard C. Bonner has been appointed general manager of the show. Manufacturers of production machinery and of accessory lines are being invited to participate. The sponsors of the show hope to hold an exhibition annually in Cleveland which has been chosen because of its central location.

Canada's War Effort Creates Labor Shortage in Metal Trades

OTTAWA—A shortage of skilled tool makers, die makers and machinists is expected to develop in Canada as a result of the Dominion's intensified war effort. Today about 375,000 men are still unemployed of whom 25,000 are skilled in some trade.

In the aircraft industry it is reported that agreements have been made with unions permitting men skilled in other trades to start in at lower rates and be trained, their rates being boosted to normal as soon as they gain experience.

There has been some talk of the Dominion government and the Provinces joining in helping to finance the retraining of men who have lost touch with their trades. These men, now scattered throughout all nine Provinces, would receive one-fourth of their pay from the government during the retraining period, which would average about 10 weeks.

Labor disputes have been held to a minimum in Canada by two factors: (1) sane labor leadership and (2) operation of the Industrial Disputes Investigation Act. The latter act, applying to public utility companies, has been in existence for years. It provides for appointment of a mediation board in case of any dispute.

Diesel Plane Engine Given CAA Approved Type Certificate

CHICAGO—A plane equipped with a 310-HP. nine-cylinder radial diesel engine was demonstrated last week at Bolling Field. Following trial flights, Secretary of War Woodring requested details on performance and construction of the engine, particularly those that might be applicable to bombers and pursuit planes. Immediately after the demonstration, an approved type certificate was issued by the Civil Aeronautics Authority, granting license for the manufacture of the engines in production quantities.

The engine was developed by the Guiberson Diesel Engine Co., which has signed a contract with Buda Company for its manufacture. For this purpose Buda has erected a $350,000 building which will be equipped and tooled to put the engines into production.

R. E. BALDWIN

A. H. TIMMERMAN

N. W. PICKERING

WATCHING WASHINGTON

Curtiss-Wright and Douglas reported likely to subcontract part of $200,000,000 aircraft orders from Allies. Will long-range bombers be used against Russia? More aircraft carriers needed

BY BLAINE STUBBLEFIELD

WASHINGTON—Don't watch the newspapers for figures on the size of the big airplane orders that Curtiss-Wright and Douglas have just received from the Allies; they aren't going to be made public and the other big orders which will soon form part of the billion dollar purchasing program won't be published either. But there is good reason to believe that these first orders total something over $200,000,000 (maybe 2,500 airplanes). Report is that Douglas will subcontract some of this work to Boeing and Consolidated, and Curtiss to North American. This order would bring total Allied airplane orders since the outbreak of the war to about 7,000. About 3,000 of these have already been delivered, Rear Admiral Towers of the Navy Bureau of Aeronautics told Congress. This is considerably higher than previous reliable estimates.

Before the new orders were placed, total Allied military purchases since the outbreak of war were about $600,000,000 of which perhaps two-thirds were for aircraft. Purchasing procedure of the Allied commission is to survey the production facilities in each product which they think they might need. Then, when a requisition comes, they invite bids from leading manufacturers. So far they have not had to pay "unreasonably" high prices except in those cases where they have had to finance plant expansions.

Considerable speculation has been aroused by the announcement that the Allies are dickering for release of our long-range "Flying Fortress" bombers, hitherto thought useful only in this hemisphere, and intimating that they might buy 50 or 60. Amateur strategists point out that the medium bombers now being bought can go 700 or 800 miles, drop bombs, and return, that this implies that from British or French bases they can raid anywhere in belligerent or prospectively belligerent territory. The big ships being discussed can go at least 1,500 miles from home and back (and, because of comparatively low speed, are of little use unless advantage is taken of range). Try that on your map. You'll find the circles include most of European Russia.

Naval officers in charge of ship design are holding their breath while the old airplane-battleship debate is argued out in the Skaggerak and the Kattegat. But no matter which way the decision goes, one thing sure is the increased importance of the airplane carrier. The Navy has already served notice on Congress that it's going to want more of the floating airports. At present, we only have three real carriers afloat, plus the old Saratoga and Lexington, which begun as battle cruisers and were converted to carriers; two other carriers are under construction, and two luxury liners convertible to carriers on short notice, which the Maritime Commission will build for a Pacific ship line.

Wagner Act Amendments Get New Chance

Enemies of the Wagner act, in cahoots with the anti-New Deal Rules Committee, rebuffed the House Labor Committee and its Chairman, Mary T. Norton, when by a vote of 9 to 1 it gave right-of-way to the Norton amendments under a rule which will permit any or all of the 14 drastic Smith amendments to be thrown in from the floor. This makes amendment of the Act by the House more than probable this session. But the Administration will continue to fight forcefully any change it considers objectionable, such as abolition of the present Board instead of the mere addition of two members. And whatever amendments can be squeezed through the House will have to face the Senate, where a few members can stop anything, within reason. On the long chance that drastic changes do get through the Senate, the President would then veto the bill, which would put it to sleep for this year.

WANTS NEW EDUCATIONAL ORDERS

WASHINGTON—The House Appropriations Committee's reasoning that educational orders are no longer needed because the Allies are "educating" American manufacturers with orders for critical items apparently was unsound. The Administration points out that the belligerents are buying hardly any critical items outside of airplanes because our plants can't get into production on them soon enough. Administration leaders are strongly urging the Senate to reinstate all or part of the "orders" fund. They also request a $40,000,000 supplement to equip the Army with new weapons.

Navy Building May Be Affected By War

There are more things behind the Senate's debate on Navy expansion than meet the eye. The isolationists say there is really no threat to this country's sea power; other Senators say there is no use authorizing construction for which there is not sufficient capacity on the ways; and some say we ought to wait and see what happens—let Congress examine the situation and make changes year by year. That point is not emphasized, but it's important. The Navy is vitally concerned over the European struggle between sea and air power, and is not sure but what drastic changes are just ahead.

Allies Not Interested in Navy Planes

In case you've been wondering why the Army does all the talking about export of late model planes to the Allies while the Navy keeps still, the answer is that France and England, in fact none of the European belligerents, are much interested in Navy type airplanes. Practically all their air operations are from land bases. The U. S. Navy is interested in liaison air operations with the Army, but Navy agrees that it is best to sell our latest Army models and go to work at once on newer ones. In fact, some Navy officers are said to be a bit disappointed because they are not in on the new quick-turnover of planes as a result of the war.

Shipbuilding Program Ahead of Schedule

The Maritime Commission has steamed steadily ahead with its subsidized building program. Bids for building four new cargo ships for American Export Lines have been requested and will be opened May 21. A contract has just been awarded the Sun company for two tankers for Keystone Tankship Corporation, on which the Government will pay only for defense features. The commission is now ahead of its 50-ships-a-year schedule. The outlook for placing all ordered vessels, operating under subsidy deals, with American flag foreign service lines is vastly improved. Destruction of shipping in the wars, and disruption of world trade routes, opens the way for the U. S. to get back on the seas.

West Coast Company Plans To Build Large Plane Engines

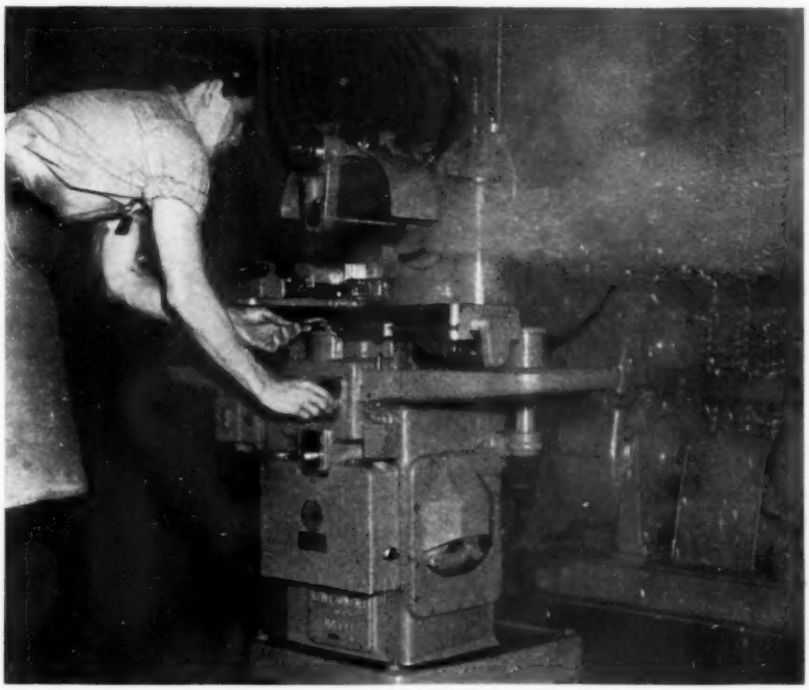
LOS ANGELES—The Menasco Manufacturing Co. plans to manufacture 770-hp. airplane engines, three or four of which can be geared to one propeller to generate as much as 3,000 hp. According to A. E. Shelton, Menasco president, preliminary drawings of the 770-hp. engine are under way, but he added that work on the project will not begin for about a year. At present the company is concentrating on its "trainer" engines of 125-165 hp., its 290-hp. engine, and its 660-hp. geared "unitwin". Coupled 770-hp. engines to develop 3,000 hp. for large planes will use the unitwin principle.

Currently, Menasco's backlog of light engines for army-type trainers is $150,000. Recently, $200,000 worth of new machine tool equipment was purchased, delivery on which has just begun. The west coast plane manufacturers have been depending largely on Pratt & Whitney, Wright and Allison for their high-horsepower engines. At present Menasco plans to produce 200 of the large engines per month in its 43,000 sq.ft. plant.

Menasco is also preparing for parts contracts in connection with gigantic Allied plane orders being placed in southern California. In this respect, it has obtained exclusive right to use the "Antioch" casting method developed at Antioch College, Ohio. The method is used to make parts immediately applicable to airplane construction, eliminating necessity of machining. Orders for such castings have already been obtained from Lockheed, North American and Douglas.

BIG SWING TO ALLIES

WASHINGTON—Hitler's invasion of Scandinavia will pay the Allies dividends in the form of larger U. S. armament appropriations which will build a munitions industry here, in supplying France and Britain with any equipment they need, and, when the time comes, in extending the Allies credit to keep up their purchases in this country. The real effect in Congress comes from representatives with big Scandinavian populations among their constituencies. A Rocky Mountain senator illustrated the big swing to the Allies by pointing out that not a single Congressman protested when the Administration announced the latest type aircraft would be shipped to the Allies. Yet a year ago isolationist Congressman made a fuss when a French expert was hurt in a crash of a new-model U. S. military plane.



10,000 R.p.m.!—*With experimental tests completed on a new high-speed milling machine designed by Vultee Aircraft production men, the company is building and putting into immediate operation three more. Time on one operation is cut from 30 hr. to 2. Details are held strictly secret*

Canadian Production Climbs to Keep Pace With Rapidly Increasing Military Activity

MONTREAL—In view of active military operations in Europe, it is expected that relatively larger orders for shells, guns and war machines will soon be given to Canada. British government appropriations for war expenditures in Canada during this first year of the war total $445,000,000 it is announced officially. While a large part of this has been for metals and foodstuffs, some $70,000,000 has been for munitions and war machines, and contracts for an additional $17,000,000 will be placed shortly.

Recently a number of new shell orders were placed with Canadian companies. Canadian Car & Foundry Co. has sufficient orders for shells from the British government to assure capacity operations of its present facilities for a year ahead. National Steel Car Corp., Dominion Engineering Co. and Robert Mitchell Co. are among others who are operating present shell-making facilities at capacity. Further intensification of war activity in Europe probably would result in further extension of present facilities.

Further Expansion Seen

Expansion of existing Canadian plants engaged in airplane production, for both the Canadian and British governments, may develop shortly. Canadian Car & Foundry Co., for instance, is planning additional facilities, both at its Fort William and Amherst plants. In addition to the $40,000,000 bomber business from Britain placed with Canadian associated Aircraft, Ltd., and for which the six companies owning the central company are making parts, further orders for pursuit planes have been placed recently in Canada by Britain.

The British war orders are over and above the $1,000,000 a day being spent by the Canadian government for war supplies, mostly in this country.

Shipbuilding Ahead of Schedule

The Canadian government's $50,000,000 shipbuilding program, drafted three months ago, is now well ahead of schedule and it is expected a considerable number of the 100 naval craft being built at Canadian shipyards will be delivered before the end of the year. Orders placed include contracts for construction of 46 patrol ships and 26 minesweepers, some of which will be turned over to the British government. Some 4,000 men are now engaged in constructing the 100 naval craft, and double this number will be so engaged by fall.

BUSINESS ITEMS

BARBER-COLMAN CO., Rockford, Ill., has appointed PEDEN IRON & STEEL CO., Houston, Tex., as its Texas representative.

BUTTERFIELD DIV., UNION TWIST DRILL CO., Rock Island, Que., has transferred its Toronto office to 208 King St. West.

CENTURY ELECTRIC CO., St. Louis, has moved its Chicago office to 600 W. Van Buren St.

GENERAL REFRIGERATION CORP. and Edward Dalton & Co., were merged with YATES-AMERICAN MACHINE CO., Beloit, Wis., at a special stockholders' meeting April 30.

HISEY-WOLF CO., Cincinnati, Ohio, has been sold to LOUIS GOLDSMITH, who will continue to operate the firm under its present name.

PLAX CORP., Hartford, Conn., has acquired Shaw Insulator Co., Irvington, N. J., manufacturer of special machinery used in making plastic containers. Organized 45 years ago, the Shaw company formerly manufactured electrical insulators. Sale includes all rights and patents, machinery, equipment and plant property.

WORM GEAR DIV., DE LAVAL STEAM TURBINE CO., Trenton, N. J., has appointed J-B Sales Engineering Co., New Haven, Conn., as engineering representative.

SALES

THOMAS E. COCKER has been appointed manager of the Detroit district office, Chain Belt Co., Milwaukee, Wis., succeeding G. A. GUNTHER. He will be succeeded as manager of the Buffalo district office by Mr. KLEMME.

W. L. CRESSMAN has been appointed Pittsburgh district sales manager for American Rolling Mill Co., Middletown, Ohio. He succeeds the late HARRY A. LORD.

F. E. DOTY has been placed in charge of the Houston, Tex., territory of McKenna Metals Co., Latrobe, Pa. C. W. MOORE has been named head of the Atlanta, Ga., branch office.

O. G. HOUSER has been named Tulsa, Okla., sales representative for Logansport Machine, Inc., Logansport, Ind.

E. F. MEYER has been placed in charge of the Houston, Tex., territory of Cutler-Mammer, Inc., Chicago, Ill.

RUSSELL M. ALLEN

RUSSELL M. ALLEN has been appointed general manager of sales, Allegheny Ludlum Steel Corp., Pittsburgh, Pa. Mr. Allen joined Allegheny Steel Co. at the close of the World War as a laborer. In 1921 he was made a clerk in the Pittsburgh sales department, and the following year was transferred to the Detroit district sales office, where he remained until 1925. He was then transferred to the Chicago office as district manager of the western territory, and in 1934 returned to Pittsburgh as assistant general sales manager for Allegheny Steel Co. Following the merger of Allegheny Steel Co. and Ludlum Steel Co., Mr. Allen was made assistant to president of Allegheny Ludlum Steel Corp., which position he retained up to the time of his new appointment.

CHESTER H. LANG, since 1932 manager of the advertising and sales promotion activities of the General Electric Co., Schenectady, N. Y., has been named manager of apparatus sales and vice-chairman of the company's Apparatus Sales Committee. He will be succeeded as manager of the publicity department by ROBERT S. PEARE, president and general manager of the Maqua Co., Schenectady, N. Y., printer and engraver affiliated with General Electric.

EARL E. THULIN has been appointed vice-president and general manager of sales, Duff-Norton Mfg. Co., Pittsburgh, Pa., lifting jack manufacturer,

U. S. Government Contracts Awarded to Metal-Working Firms

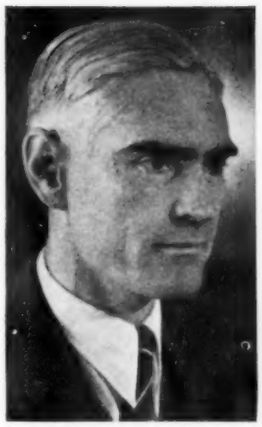
(Tool Contracts on Page 306l)

Contractor	Gov't Agency	Commodity	Amount
National Forge & Ordnance Co., Irvine, Pa.	Navy	Gun barrel forgings	$62,250
Crosby Steam Gage & Valve Co., Boston, Mass.	Navy	Gages	20,858
Worthington Pump & Machinery Corp., Harrison, N. J.	Navy	Diesel generator	55,264
Frick Co., Waynesboro, Pa.	Navy	Cold storage machinery	94,074
Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.	Navy	Bridge cranes	157,560
Murphy Elevator Co., Louisville, Ky.	Navy	Elevators	46,444
General Elevator Co., Baltimore, Md.	Navy	Elevators	38,731
American Transformer Co., Newark, N. J.	Signal Corps	Rectifiers	45,840
Midvale Co., Nicetown, Pa.	Navy	Gun forgings	308,697
Erie Forge Co., Erie, Pa.	Navy	Housing forgings	127,341
Pittsburgh Screw & Bolt Corp., Pittsburgh, Pa.	Navy	Nuts and bolts	31,514
Standard Machinery Co., Providence, R. I.	Navy	Roller paths	60,356
John Wood Mfg. Co., Conshohocken, Pa.	Navy	Steel boxes	168,431
American Brass Co., Torrington, Conn.	Ordnance	Cartridge cups	37,200
Walworth Co., Greensburg, Pa.	Navy	Valves and fittings	37,450
Victor R. Browning & Co., Willoughby, Ohio.	Navy	Bridge crane	34,990
York Ice Machinery Corp., York, Pa.	Navy	Refrigerating plant	33,165
National Supply Co., Superior Engine Div., Philadelphia, Pa.	Navy	Diesel engines	122,592
United States Motors Corp., Oshkosh, Wis.	Signal Corps	Power unit	104,705
Worden Allen Co., Milwaukee, Wis.	TVA	Valves	26,952
Teletype Corp., Chicago, Ill.	Navy, CAA	Communication systems	66,879
Elwell-Parker Electric Co., Cleveland, Ohio.	Air Corps	Electric trucks	22,660
Yale & Towne Mfg. Co., Automatic Transportation Co. Div., Chicago, Ill.	Air Corps	Electric trucks	19,450
Crescent Truck Co., Lebanon, Pa.	Air Corps	Electric trucks	11,620
Mercury Mfg. Co., Chicago, Ill.	Air Corps	Electric trucks	11,660
Fleetwheels-Gliders, Inc., Bristol, Pa.	QMC	Trailers	88,125
Ransom & Randolph Co., Toledo, Ohio.	Navy	Dental burrs	26,742
David White Co., Milwaukee, Wis.	Navy	Sextants	37,000
Sperry Gyroscope Co., Brooklyn, N. Y.	Navy	Automatic pilots	950,136
Diebold Safe & Lock Co., Canton, Ohio.	Ordnance	Motor parts	27,580
Edwards Mfg. Co., Cincinnati, Ohio.	Navy	Practice bombs	79,166
Link-Belt Co., Indianapolis, Ind.	Navy	Chains	35,579
Consolidated Steel Corp., Los Angeles, Calif.	Engineer Corps	Crest gates	107,884
C. H. Cowdrey Machine Works, Fitchburg, Mass.	Ordnance	Howitzers	174,208
National Tube Co., McKeesport, Pa.	Ordnance	Shell forgings	134,384
J. R. Hunt & Co., Baltimore, Md.	QMC	Maintenance equipment	27,826
American Brass Co., Waterbury, Conn.	Navy	Tubing	51,904
Chrysler Corp., Detroit, Mich.	Ordnance	Bomb fuses	97,079
C. H. Wheeler Mfg. Co., Philadelphia, Pa.	Navy	Air ejectors	46,280
Joshua Hendy Iron Works, Sunnyvale, Calif.	Interior	Tube valves	26,249
Buffalo Forge Co., Buffalo, N. Y.	Navy	Ventilation equipment	48,180
Northern Pump Co., Minneapolis, Minn.	Navy	Fuel oil pumps	202,177
General Electric Co., Schenectady, N. Y.	Navy, TVA, Interior	Electrical equipment	179,446
Crocker-Wheeler Electric Mfg. Co., Ampere, N. J.	Navy	Motor-generators	27,155
Harley-Davidson Motor Co., Milwaukee, Wis.	QMC	Motorcycles	86,822
Curtiss-Wright Corp., Curtiss Airplane Div., Buffalo, N. Y.	Navy	Airplane parts	129,580
Bendix Aviation Corp., Eclipse Aviation Div., Bendix, N. J.	Air Corps	Energizer assemblies	54,504
Glenn L. Martin Co., Baltimore, Md.	Air Corps	Maintenance equipment	30,351

with headquarters in Chicago, Ill. C. N. THULIN continues in Chicago as vice-president and will act in a sales capacity as a special representative in all territories. W. I. FLOYD has been named assistant general manager of sales in addition to his present capacity of assistant to the president, with headquarters at the company's general offices in Pittsburgh.

CHARLES G. PYLE, sales manager Hygrade Lamp Div., Hygrade Sylvania Corp., Salem, Mass., has established headquarters at the company's offices in New York City.

NAMES in the NEWS



J. CARLTON WARD, JR.

A. C. CUMMINS

JAMES C. MORGAN

J. CARLTON WARD, JR., vice-president and a director of United Aircraft Corp. and general manager of its Pratt & Whitney Div. in Hartford, Conn., has resigned. Mr. Ward joined the organization in 1935 as assistant to the general manager at Hartford, and two months later became assistant general manager. Since November, 1938, he has been vice-president of United Aircraft and general manager of the Pratt & Whitney Div.

FERRIS M. ANGEVIN, secretary Cincinnati Milling Machine Co., Cincinnati, Ohio, has been elected a member of the board of directors.

COL. JAMES G. COWLING has been appointed special representative of Allegheny Ludlum Steel Corp., Pittsburgh, Pa., in its relations with federal government agencies. Colonel Cowling's office is located in Washington, D. C.

JOSEPH ALOYSIUS CREEVY, formerly in the research department of the Stanley Works, Bridgeport, Conn., has been named assistant to the general manager of Sharon Tube Co., Sharon, Pa.

WILLIAM R. HOYT, former Philadelphia Div. works manager Yale & Towne Mfg. Co., Stamford, Conn., has been named general manager of the company's Stamford plant. He succeeds RICHARD G. PLUMLEY, who has resigned to become general manager of the Crown Fastener Div. of Cotton Spool Co., New York, N. Y.

A. KING MCCORD, former vice-president Oliver Farm Equipment Co., Chicago, Ill., has been named first vice-president. JOSEPH M. TUCKER has been made vice-president in charge of sales, while MERLE S. TUCKER has also been elected a vice-president.

E. J. PARKER has been elected president of Howard Aircraft Corp., Chicago, Ill., succeeding BEN O. HOWARD, founder.

A. C. CUMMINS has been appointed general superintendent of the Youngstown, Ohio, district operations for Carnegie-Illinois Steel Corp., Pittsburgh, Pa. He succeeds L. N. MCDONALD, who retires May 1 upon completion of 55 years of service with subsidiaries of U. S. Steel Corp.

A graduate of Lehigh University, Mr. Cummins has been associated with Carnegie-Illinois and the former Carnegie Steel Co. since 1911, when he was employed as a draftsman at the Duquesne, Pa., works. For several years he served in various engineering, construction and operating capacities at that works, and in 1919 was named superintendent of the electrical department. He was appointed assistant general superintendent of the plant in 1932, and a year later was named general superintendent. Since August 1, 1936, he has been assistant manager of Pittsburgh district operations.

NORMAN L. DEUBLE, formerly associated with the Republic Steel Corp., has become connected with Copperweld Steel Co., Warren, Ohio, as assistant to the vice-president. A graduate of the Case School of Applied Science, Mr. Deuble is a member of the A.S.M. and of the S.A.E.

FRANK A. GARVEY, assistant superintendent Union Drawn Div. of Republic Steel Corp., Cleveland, Ohio, has been appointed superintendent. WALTER C. GUMPF, former assistant service manager, has become assistant superintendent. HARRY L. WILLIAMS has been promoted from the planning department to succeed Mr. Gumpf.

DAVID C. PRINCE, since 1931 chief engineer of the Switchgear Dept., General Electric Co., Philadelphia, Pa., has been named manager of the Commercial Engineering Dept., succeeding the late vice-president E. W. ALLEN. Mr. Prince has also been named a member of the company's advisory committee and of the apparatus sales committee, with headquarters in Philadelphia.

JAMES C. MORGAN, former Philadelphia district sales manager Yale & Towne Mfg. Co., Stamford, Conn., has been named general manager of the Philadelphia plant.

Mr. Morgan first became associated with Yale & Towne in 1920, when he went with the company's Stamford office to take charge of electric truck sales. He was subsequently made assistant to the president, which position he held until he was placed in charge of the Materials Handling Div. Nine years ago this division became too large to be handled in Stamford, and was moved to the Philadelphia plant it now occupies.

F. L. LAQUE, assistant director of technical service on mill products in New York City, International Nickel Co., New York, N. Y., is now engaged in development activities on applications of both ferrous and non-ferrous nickel-containing alloys. DR. WILLIAM A. MUDGE, formerly works metallurgist of the company's rolling mill at Huntington, W. Va., and who recently joined the technical service section of the Development & Research Div. in New York, has been appointed assistant director of technical service to succeed Mr. LaQue.

FREDERICK R. SCHAEFER has been placed in charge of coordination of all pressed steel operations of Republic Steel Corp., Cleveland, Ohio. Mr. Schaefer, who has been general manager of the Niles Steel Products Div., will have jurisdiction over this division and over the Superior Div. at Elyria, Ohio. He will also serve as general manager of the Pressed Steel Div. of Truscon Steel Co., at Cleveland, the position previously held by HARRY WOODHEAD, who has resigned to become president of Aviation Mfg. Corp.

HARRY WOODHEAD, for the past thirteen years vice-president and general manager of the Cleveland, Ohio, plant of Truscon Steel Co., succeeds W. H. BEAL as president of Aviation Mfg. Corp., Williamsport, Pa.

PLANT EXPANSION

ALUMINUM CO. OF AMERICA, Pittsburgh, Pa., is planning additions to its Los Angeles, Calif., plant, which will cost approximately $2,000,000 and will double the output and payroll of that works. Much of the expanded plant will be used for the manufacture of rivets used extensively in airplane construction. Additions will be twice the size of the existing plant and will include shops for production of extruded shapes used in fabricating airplane parts.

AMPCO METAL, INC., Milwaukee, Wis., will erect a three-story office building at a cost of $100,000.

DONNELLY PATTERN & ENGINEERING CO., Detroit, Mich., is planning a new plant which will represent an investment of approximately $100,000 for building and equipment. It will be devoted to an entirely new line of products developed by the company.

GOODRICH ELECTRIC CO., Chicago, Ill., manufacturer of industrial lighting fixtures, is modernizing its plant and constructing a large one-story extension to be completed in July.

SKY CHIEF RADIO CORP., New York, N. Y., has leased 24,000 sq. ft. of floor space in South Manchester, Conn., and will center all operations in the Connecticut plant.

SUPERIOR TANK & CONSTRUCTION CO., Los Angeles, Calif., is erecting an addition costing $6,500.

OBITUARIES

CHARLES RANSOM BROTHWELL, 56, president and general manager Russell Jennings Mfg. Co., Chester, Conn., died April 7.

CHARLES WILLIAM EDGERTON, 72, head of the Penfield Saw Works, Bristol, Conn., died April 5 at a Hartford, Conn., hospital following a brief illness.

CHARLES W. FRANCIS, 57, and Mrs. Francis were killed April 19 in the wreck of the New York Central's *Lake Shore Limited* at Little Falls, N. Y. Mr. Francis had been production engineer of Electric Auto-Lite Co., Toledo, Ohio, for seventeen years. Previously he had been associated with Robbins & Myers, Inc.

ADDA G. KARCHER, 51, assistant production supervisor American Brass Co., Kenosha, Wis., died April 8 at his home in that city. Mr. Karcher had been associated with the firm since 1906.

WALTER J. KOHLER

WALTER JODOK KOHLER, chairman Kohler Co., Kohler, Wis., maker of plumbing supplies, and 1929–1930 Governor of Wisconsin, died suddenly April 21 at his home in that city. Sixty-five years of age, he had apparently been in good health.

Mr. Kohler joined the company, founded by his father, at the age of fifteen, working in the enameling department. He became president in 1905, five years after his father's death, and was named chairman in 1937.

JOHN S. GULLBORG, 76, founder and retired president Alemite Die Casting & Mfg. Co., Chicago, Ill., died April 12.

ARTHUR M. JOHNSTON, 39, for fifteen years Milwaukee, Wis., district manager for Greenfield Tap & Die Corp., died April 11 at his home in Wauwatosa, Wis., following a brief illness.

FRANK C. KIP, 56, president Automotive Thrust Bearing Corp., Chicago, Ill., and a former director of the National Standard Parts Association, died April 16.

ROBERT E. MASTERS, 91, a pioneer in the steel casting industry and an early contributor to AMERICAN MACHINIST, died recently in San Diego, Calif. Among his achievements was the successful casting of steel car wheels, which became standard practice.

CHARLES H. JOHNSON, vice-president Gisholt Machine Co., Madison, Wis., died suddenly April 23.

WILLIAM WALTER WILCOX, 38, vice-president and treasurer Wilcox-Crittenden Co., Middletown, Conn., marine hardware manufacturer, died recently.

MEETINGS

AMERICAN GEAR MANUFACTURERS ASSOCIATION. Annual convention, Grove Park Inn, Asheville, N. C., May 20 through 22.

AMERICAN IRON & STEEL INSTITUTE. Forty-ninth general meeting, Hotel Waldorf-Astoria, New York, N. Y., May 23.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting, Hotel Bancroft, Worcester, Mass., May 1–3.

AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J., June 24–28.

ASSOCIATED MACHINE TOOL DEALERS OF AMERICA. Spring convention, Claridge Hotel, Atlantic City, N. J., May 13 and 14.

MACHINE TOOL ELECTRIFICATION FORUM, East Pittsburgh, Pa., works of Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., May 6–8.

NATIONAL METAL TRADES ASSOCIATION. Forty-second annual convention, Biltmore Hotel, New York, N. Y., May 21 and 22.

SOCIETY OF AUTOMOTIVE ENGINEERS. National production meeting, Hartford, Conn., May 6 and 7. Summer meeting, The Greenbrier, White Sulphur Springs, W. Va., June 9–14.

U. S. Government Contracts Awarded to Tool Makers

(Other Metal-Working Contracts on Page 306)

Contractor	Gov't Agency	Commodity	Amount
Gisholt Machine Co., Madison, Wis	Navy	Turret lathe	$15,648
Alliance Machine Co., Alliance, Ohio	Ordnance	Drop hammers	29,665
Kearney & Trecker Corp., Milwaukee, Wis.	Ordnance	Milling machines	13,211
Lodge & Shipley Machine Tool Co., Cincinnati, Ohio	NACA	Lathes	12,818
Morton Mfg. Co., Muskegon Heights, Mich.	Navy	Shaper	13,150
Tinius Olsen Testing Machine Co., Philadelphia, Pa	Navy	Testing machine	11,750
Consolidated Machine Tool Corp., Rochester, N. Y.	Navy	Engine lathes	75,560
Acme Machine Tool Co., Cincinnati, Ohio	Navy	Turret lathe	11,535
Potter & Johnston Machine Co., Pawtucket, R. I.	Ordnance	Chucking machines	23,600
Niles-Bement-Pond Co., Pratt & Whitney Div., Hartford, Conn.	Ordnance	Reaming machines	34,200
H. A. Smith Machinery Co., Syracuse, N. Y.	Ordnance	Engine lathe	20,450
American Tool Works Co., Cincinnati, Ohio	Navy	Engine lathe	36,677
Acme Machine Tool Co., Cincinnati, Ohio	Navy	Turret lathes	17,739

SHOP EQUIPMENT NEWS

Single Lever Controls Speeds and Feeds On Cincinnati Dial Type Milling Machines

Designed for rapid metal removal to a good finish and to close limits of accuracy, with convenient and easy manipulation of operating controls, the line of plain, universal and vertical dial type milling machines recently placed on the market by the Cincinnati Milling Machine Co., Cincinnati, Ohio, are built in three sizes: Nos. 2, 3, and 4. They are available with two speed-feed ranges, "medium speed" and "high speed".

Speeds and feeds are controlled by a single lever at the front of the machine, and duplicated at the operator's rear working position. The lever has two positions, "speed" and "feed". When moved to the "speed" position, for example, the speed dial at the left-hand side of the column rotates. When the lever is returned to neutral, the dial stops, and the proper gears are in mesh to obtain the spindle speed indicated by an arrow. The machine does the work of shifting gears; no effort is required on the part of the operator other than moving the small lever that releases the power for shifting the gears. Feeds are changed in the same manner.

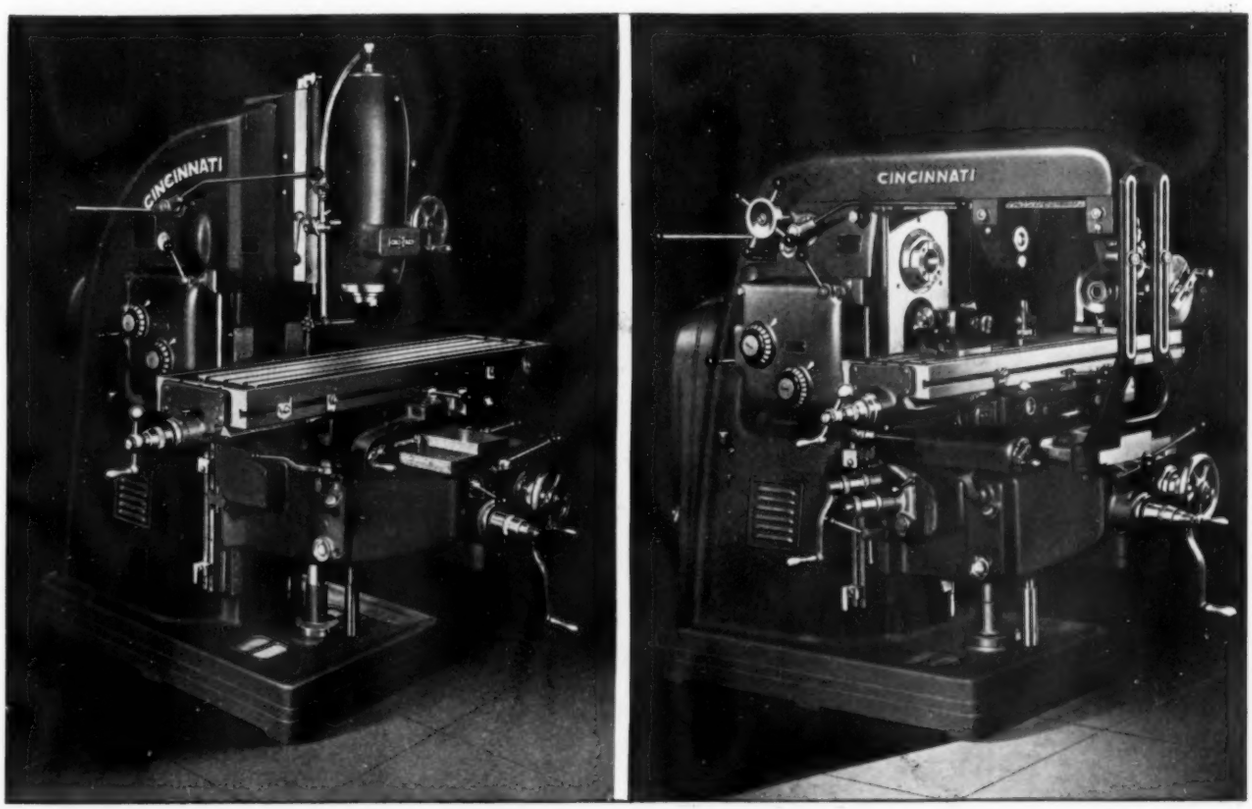
All power control and hand adjustment levers are grouped conveniently at the front operating position, providing complete control of the machine without need for the operator walking or stretching. All of these controls, both hand and power, are duplicated at the rear working position on the left-hand side of the column.

Power feed controls at the front of the knee have been rearranged to provide increased convenience of operation. Both cross and vertical power controls are near the top of the knee, making it unnecessary for the operator to bend over to grasp them. Power longitudinal, cross and vertical feeds are engaged by independent feed levers. They are directional controls; feed movement is in the direction in which the lever is moved. All sizes and styles of these machines have power rapid traverse in six directions.

An improved brace is included as standard equipment with horizontal machines. It clamps to the exposed top surface of the knee, and therefore may be set as close as desired to the saddle. With this design, the operator may take advantage of the combined rigidity of short arbors and the brace. An extensive use of plastics has been made in these dial-type millers, of which the No. 3 vertical and the No. 2 universal units are illustrated. The large speed and feed index dials at the side of the column have white numbers on a red plastic base. These dials will maintain their original form during the life of the machine. All power control levers terminate in black plastic knobs.

Four anti-friction bearings are incorporated in the spindle mounting, rear bearings being mounted in a sleeve to permit normal expansion and contraction in the length of the spindle. Automatic lubrication of the principal units reduces daily attention to little more than a quick inspection. All parts within the column and knee units are lubricated automatically, while the parts within the saddle are lubricated by a single oil-shot system.

The Meehanite metal column is



heavier, wider at the base and at the overarm. Heavy ribbing throughout the column increases its strength, permitting the operator to run the machine at maximum cutting capacity. The overarm has been widened.

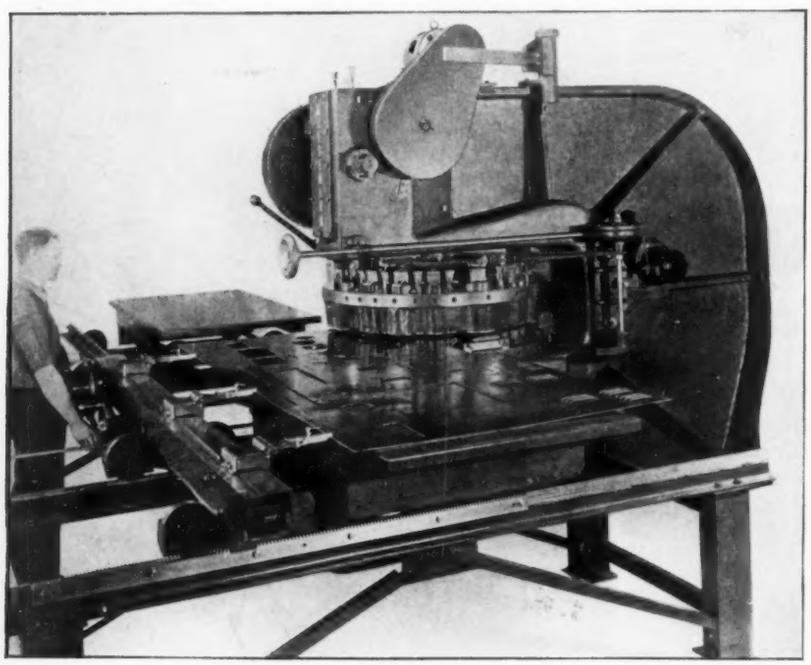
An hydraulic device has been incorporated with the spindle drive starting lever. Connected with the link mechanism, an hydraulic Servo control takes over the work of engaging the clutch, relieving the operator of all starting effort except a light touch on the starting lever. This permits the spindle to be "inched" along with negligible effort. There is positive and full engagement of the clutch when the spindle is rotating; engagement is instantaneous; and, since the Servo control also operates the spindle brake, the spindle rotation stops instantaneously when the clutch is disengaged. All power control levers are of the ball-handle design, giving the operator a more comfortable grip.

Wiedemann Power-Operated Turret Press Can Be Fitted With Locating Table

The Model R-8 motor-driven turret punch press developed by Wiedemann Machine Co., 1815-31 Sedgley Ave., Philadelphia, Pa., has a 54-in. throat and can be equipped with a spacing table which will locate holes in sheets up to 50 in. wide, 100 in. long and ⅛ in. thick. This table is offered as an accurate means to locate a sheet under the punching station, to reach any point required in order to pierce, notch corners, or cut out openings.

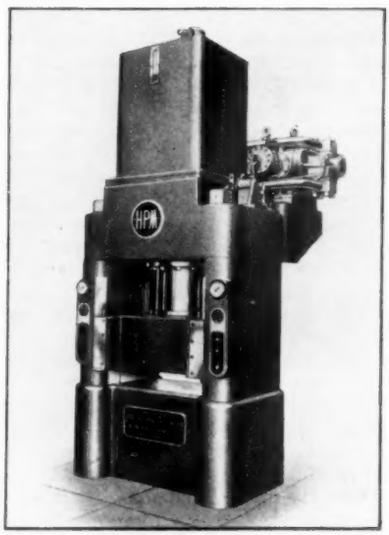
Accurate movements are provided, in and out and crosswise, at 90 deg. to each other, each unit being mounted on ball bearings to provide quick settings. Settings are measured by full length steel scales with large graduated dials for fine accuracy. Hand wheels are provided for moving the table, each turn of the wheel giving a 6-in. movement of sheet. Clamping of the table is by means of a small lever at each hand wheel, convenient to the operator.

The Type R-8 turret punch can be provided with 12 to 32 stations. Weight of the machine without spacing table is 2,100 lb. It will punch a 5-in. diameter hole in ¼ in. thick mild steel. With sheared punches, a 6 in. diameter or 6x6 in. square opening can be punched in ¼-in. mild steel. Upper and lower turrets are geared together and locked in position by a method which provides exact alignment. The turrets can be operated either by handwheel or motor drive. Index pins are located at the rear of the turret where they will not be affected by scale or dirt. Standard stroke of the machine is 1⅜ in., but this can be varied to suit requirements. Standard clearance between dies of strippers is ⅞ in. with a positive stripper at each station. Speed of the machine is 100 strokes per min. when driven by a 3 hp. 1800 r.p.m. motor. Without spacing table, the machine occupies floor space measuring 126 in. long and 51 in. wide. The machine is 8 ft. high. Floor space required by the machine and table combination is 16x 16 ft. It is self-contained.



H-P-M Hydraulic Press Makes 47 Cycles Per Minute

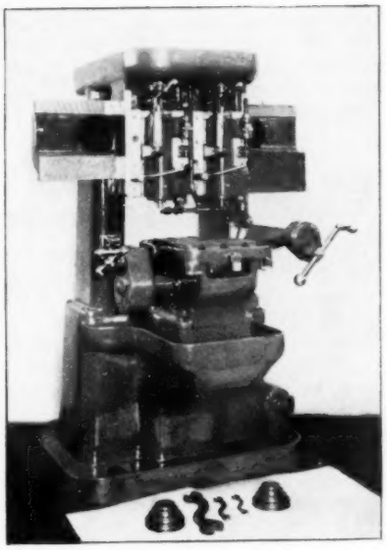
Using a 3-in. working stroke, the press shown can be used for up to 47 complete cycles per minute. Pressure can be built up on the solid bed to a maximum of 250-tons on each cycle. Developed by the Hydraulic Press Mfg. Co., Mt. Gilead,



Ohio, this press incorporates the "Fastraverse" means of rapid traversing the pressing member to and from the work. The pressing surface advances to the work by gravity, while oil refills the pressure cylinder by gravity, flowing unobstructed through a surge valve mounted in the open end of the press cylinder. The valve closes automatically as soon as pressure is built up in the main cylinder, and opens automatically as soon as pressure is released. The main ram, on its return stroke, actually pushes the oil from the main cylinder back into the overhead oil reservoir. The pressure generator is used only to build up a predetermined pressure in the main cylinder after the cylinder has been prefilled, and to apply pressure to the pushback rams for returning the pressing member to its original starting position. No operating valves are used between the pressure pump and pressure cylinders.

N. Y. Vertical Profiler Machines Small Parts

The No. 12M high-speed vertical profiler and miller offered by New York Tool Co., Inc., 406 Broome St., New York, N. Y., is offered for economic manufacture of small parts requiring accurate interchangeability. The two-spindle machine shown is standard, single-spindle machines can be furnished on special order. Crossrail is designed so that the slide castings carrying the spindles and the motors



are in balance. There is a removable filler block between the base and table housings so that the maximum distance of the spindle nose to the table may be increased or decreased without the use of riser blocks under the side housings. Spindles are equipped with high-speed pre-loaded precision bearings suitable for speeds up to 2,000 r.p.m. If specified, the machines can be equipped with bearings suitable for maximum speeds of 10,000 r.p.m.

Spindles of this profiler are driven independently by dynamically balanced vertical motors through four-step V-belt drives. The motors are suspended from swiveling cams, so that with a slight turn the tension of the belt may be adjusted to suit individual requirements. Positive vertical micrometer adjustable stops are provided for each spindle, with dials graduated in 0.001 in. Copying pins are carried in blocks, which have a taper attachment, controlled by a screw to simplify the final setting. An Alemite lubrication system is provided for all bearings.

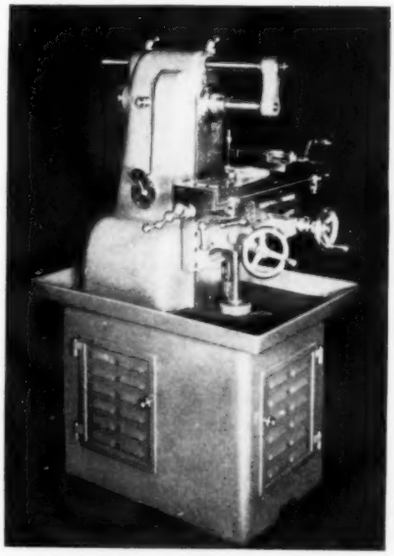
Specifications: Working surface of table, 12¾ x 15¼ in.; longitudinal table travel, 23 in.; distance from table top to bottom of cross slide, with 4-in. filler blocks, 11½ in. max., 7½ in. min.; distance from table top to spindle end, 4 in. min., 8 to 12, max. Distance between uprights, 18½ in.; height from floor to cross rail, 49 in.; spindle speeds with 3,600 r.p.m. motor, 980–1440–1980–2700 r.p.m.; net weight of two-spindle machine with standard equipment, approximately 3,450 lb.

Hardinge Precision Toolroom Miller Permits Fine Accurate Finishing at High Speeds

Replacing the Type BB5 miller, the Type TM precision preloaded ball bearing toolroom miller announced by Hardinge Bros., Inc., Elmira, N. Y., has been designed to take heavy cuts accurately. A longer vertical travel is incorporated to allow for the use of the index head in a vertical position. Horizontal spindle nose of the miller and the spindle nose of the index head are of the same dimensions, thus allowing interchangeability of chucks and other spindle nose fixtures. Collets also are interchangeable between the machine spindle and the index head spindle. The machine spindle has been extended over the table to permit all end mills to reach the work without the use of adapters.

The Type TM miller provides either of two high spindle speed ranges, from 110 to 1850 r.p.m., or 110 to 2,775 r.p.m., the low spindle speed of 110 r.p.m. being retained for use when required. The machine is equipped with anti-friction bearing throughout; the overarm having antifriction bearings so that it will support the arbor properly at high spindle speeds.

This machine is operated easily by the use of one lever only. This lever operates the electrical control mounted on a panel inside the miller column. The steel pedestal driving unit completely incloses the drive, in which there are no loose pulleys,

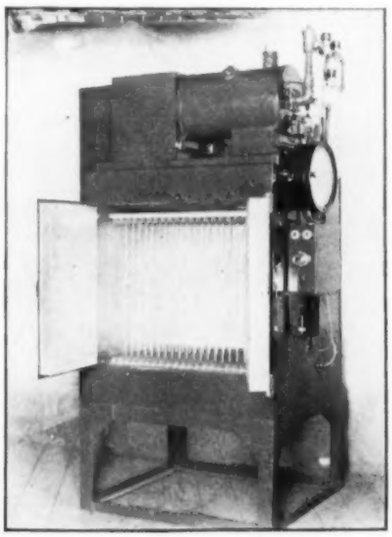


gears or clutches. The bevel gears and transfer feed nuts are completely inclosed in the boxtype knee to prevent entrance of foreign matter. All slides are taper gibbed. Large dials are provided; these are graduated in thousands of an inch. The machine is offered with or without power feed for longitudinal travel of the table. This power feed is V-belt driven, 32 feeds being available.

Specifications: Longitudinal travel of table, 14 in.; longitudinal travel of table with power feed, 11½ in.; transverse movement of table, 5⅛ in.; vertical adjustment of knee, 13¼ in.; maximum distance from top of table to center of spindle, 12 in.; working surface of table, 20¾ x 6 in.; over-all size of table, 25 x 6 in.; floor space required, 46 x 62 in.; weight, 870 lb.

Despatch Tempering Furnace Developed for Saw Coils

A line of tempering and drawing furnaces has been developed by Despatch Oven Co., 622 Ninth St. S.E., Minneapolis, Minn., for a wide range of work. The particular furnace shown is arranged for tempering and drawing



bandsaw blades which are wrapped in coils and rolled into the furnace in an upright position. The framework shown in the furnace is used to hold the coils in an upright position; it can be removed and the furnace used for other work.

This furnace has a maximum temperature of 800 F. This can be increased to 1,250 F. by increasing the insulation thickness, by lining the sides with stainless steel and by reinforcing it for higher temperature operation. The furnace shown is 35 in. wide, 30 in. high and 30 in. deep. A controlled combustion air heater, mounted at the top of the unit supplies heat to the furnace. Air is forced from the ducts at the bottom of the furnace; recirculating ducts are located at the top. Air travel is vertical. By using a large capacity fan uniformity within 3 to 5 deg. plus or minus is obtained easily.

Hammond Floor-Type Grinder Has 36-in. Between Wheels

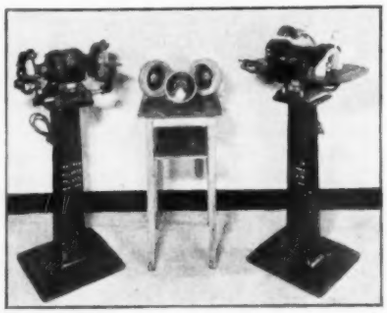
The Type WS wide swing grinder, announced by Hammond Machinery Builders, Inc., 1618 Douglas Ave., Kalamazoo, Mich., is a four-bearing

unit with 14-in. boiler plate guards. Distance between wheels is 36 in. Floor base measures 24x24 in. Net weight is 915 lb. A 3 hp. motor drives the two grinding wheels.

Prosser Grinding Set-Up Available for Tool Work

A complete set-up for grinding cemented carbides, Stellite, or high-speed steel single-point tools, is offered by Thomas Prosser & Son, 120 Wall St., New York, N. Y. This set-up consists of a simple high-power grinder, having a coarse straight vitrified wheel on one end for hogging down shank steel, and a rough open-grain straight silicon carbide wheel for rapidly roughing down chipped or badly worn carbide tools. Rests on this grinder should be set so that the shank and tip are roughed down to a clearance angle of a few degrees more than desired on the finished tool.

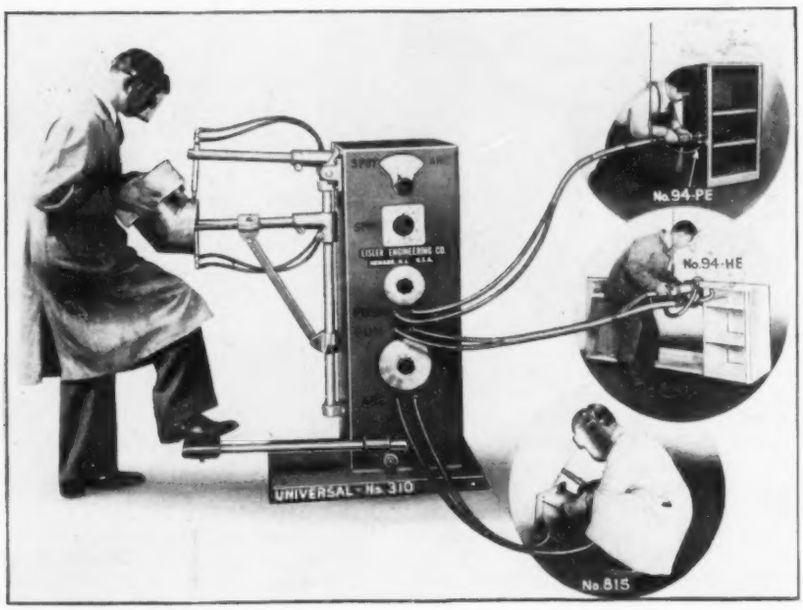
Then, on the table grinder, a comparatively small amount of grinding on the surface of the silicon carbide cup wheel, with a final touching up on the finishing wheel will result in a perfect cutting edge, free of nicks, with flat clearances held closely to the desired angles. The finishing



wheel can be either silicon carbide or diamond. Tables of this carbide grinder can be adjusted to the angle desired easily. Motors for both of the grinders are reversible so that either left or right-hand tools can be ground with the wheel rotating toward the cutting edge.

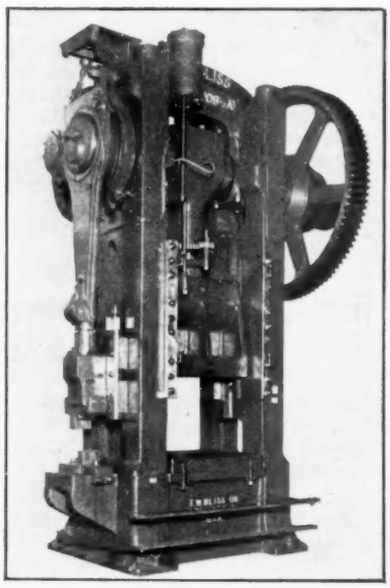
Eisler Universal Welder Suitable for Arc Welding

The No. 310 universal spot welder, offered by the Eisler Engineering Co., 745 S. 13th St., Newark, N. J., is especially suited for spot welding all kinds of sheet metal work. In addition, the unit can be used as an a.c. transformer-type arc welder, as a hand-operated push type spot welder, or as an air-operated gun welder. The foot-operated conventional spot welding head also can be arranged for air operation. The machine is supplied with individual control so that each operation can be performed without interfering with the other. It is available with four sizes of spot welder, from 10 to 50 kva. and with 200, 300 and 400 amp. arc units.



Bliss Heavy-Duty Press Designed for Trimming

The No. 209½-A straight-sided single crank press illustrated is one of a line of trimming presses developed by the E. W. Bliss Co., 53rd St., and Second Ave., for use in forge shops and kindred industries. These presses are equipped with an outside-slide cut-off attachment for cutting the flash from bars, punching holes and trimming. Press is of tie rod construction with steel tension rods shrunk-in at 100 per cent over the

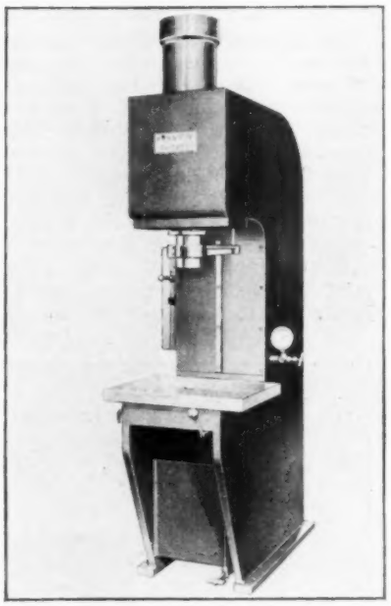


press rating. Solid straps with a cross grip action supplant the old split clamping action in the connections, thus insuring positive holding with increased strength.

Other features included on these presses are a rolling key clutch, V-belt motor drive, extra wide bed and slide, and air counterbalance for the slide. Each press is furnished with a floor line lubrication system which reaches the main bearings and other points through pressure fittings within easy reach of the man on the floor. The machine shown is single geared and operates at 25 strokes per minute. It weighs approximately 57,500 lb.

Hannifin Forcing Press Has Built-In Power Unit

Hannifin Mfg. Co., 621–631 S. Kolmar Ave., Chicago, Ill., has developed a 25-ton capacity hydraulic forcing press with welded steel frame construction. This press features a built-



in motor driven hydraulic power unit and senistive pressure control which provides an infinitely variable pressure. Welded steel frame construction, with the hydraulic power unit completely inclosed within the frame, reduces floor space required. The press shown has a stroke of 24 in., a 30x22 in. table, a gap of 25 in., a reach of 15 in., and an over-all height of 113 in. Distance from table to floor is 40 in. Operating speeds are 83 in. per min. on the power stroke and 157 in. per min. on the return stroke. The hydraulic power unit is driven by a 10 hp. motor.

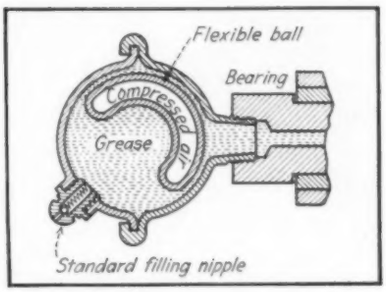
Simplex Automatic Lubricator Incorporates Neoprene Ball

Continuous feeding of lubricant to its bearing, regardless of viscosity or temperature changes, is claimed for the automatic lubricator now being sold by the Simplex Mfg. Co., 1504 Broadway, Detroit, Mich. This lubricator is intended for replacement of grease fittings or oil cups on vehicles and machinery of all types, as well as for original equipment. One size, ¼ oz. capacity, now is available.

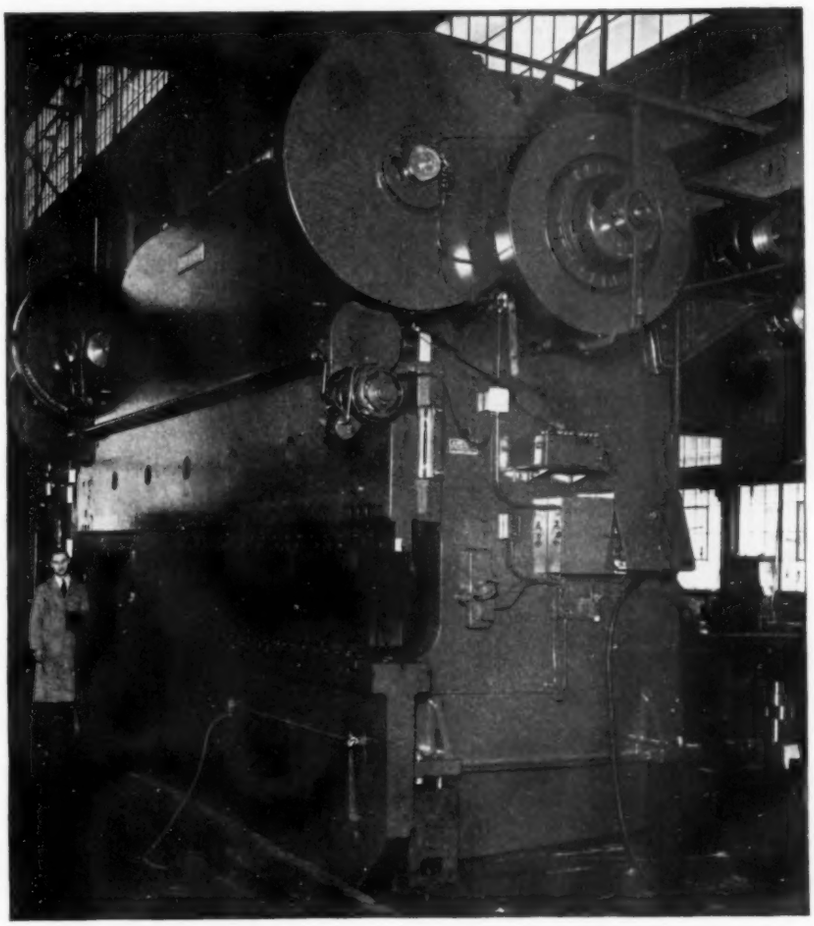
The lubricator is essentially a spherical steel shell with a grease fitting and a ⅛ in. pipe thread connection for insertion in the bearing hole or a suitable adaptor, of which several patterns are available. Inside the steel shell are a hollow Neoprene (grease-resistant synthetic rubber) ball and an outlet channel that prevents the ball from clogging the outlet.

When grease or fluid oil is forced into the grease fitting with conventional equipment, the internal pressure may rise momentarily to 1,500 lb. per sq. in. This pressure collapses the rubber ball and compresses the air within, thus storing energy for feeding lubricant to the bearing. Resistance of the bearing may be only 160 lb. per sq. in. Consequently, the ball expands and flushes lubricant through the bearing until the internal pressure equals the bearing resistance.

The expanding ball constantly presses lubricant into the outlet, from whence it is picked up by wiping action of the bearing surfaces only when the bearing is in motion. The amount of lubricant actually contained in a bearing is relatively small as compared to the charge normally remaining in the reservoir, even when bearing resistances vary widely. Since the amount of lubricant fed to the bearing is a function only of the wiping action of the bearing surfaces, the charge is sufficient for a relatively long period.



Cincinnati Series 340 All-Steel Press Brake Made for Forming Aluminum Aircraft Alloys



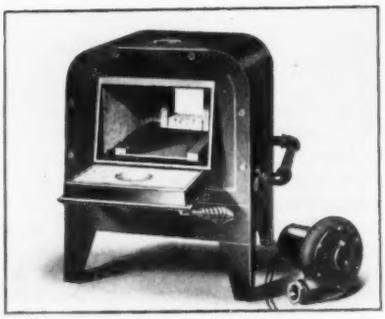
This series 340 all-steel press brake manufactured by the Cincinnati Shaper Co., Cincinnati, Ohio, is said to be the largest press brake ever built for the aircraft industry. It is arranged for corrugating and forming aluminum aircraft alloys. Housings, bed and ram are of rolled steel plate. Distance between housings is 18 ft. 6 in.; total over-all die surface is 21 ft. 3 in. It is equipped with taper adjustment to the ram, air counter balances, tonnage load indicator, electric clutch control, and automatic electric overload clutch release.

Electric welding and hollow-head screws unite the component parts of this press so as to secure the action of a solid number rather than of a built-up section. Where screws are used in these members to draw the plates into place, the screws themselves are welded as well as the plates, so that they become an integral part

of the member with no chance of working loose. Deflection is practically eliminated by the heavy design of the main members and the continuous connections secured by welding.

Johnson Furnace Made For High-Speed Steels

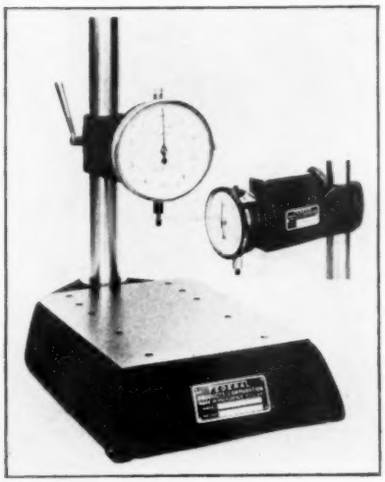
Although designed primarily for hardening high-speed steels, the No. 70 heat-treating furnace offered by the Johnson Gas Appliance Co., 520 East Ave., Cedar Rapids, Iowa, can be used for carbon and intermediate steels, and is recommended for hardening punches, dies or tools. Firebox temperatures of 2500 F. can be obtained. Firebox lining is 2½ in. of insulating refractory. A carborundum hearth is standard equipment. The burners are placed under the hearth.



Blowers have cast aluminum wheels and incorporate air and gas adjustment for temperature control and regulation. Doors in front and rear allow heating bars and rods. The furnace is available in two sizes, and in either bench or pedestal styles.

Improved Federal Comparator Supports Indicator by Back

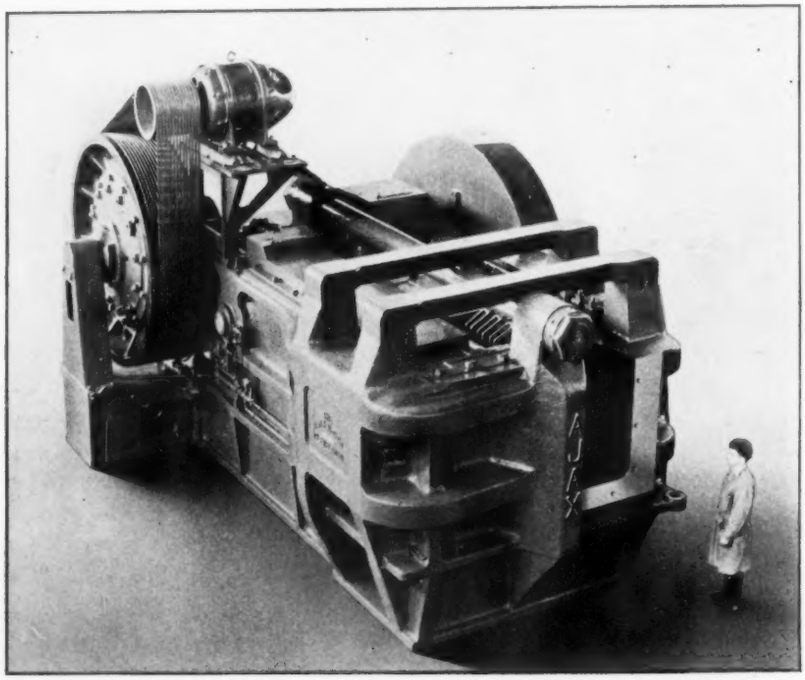
Recommended especially for setting and checking other gages to be used in production inspection, but also suitable for being used directly in production, the Model NB-60 comparator, offered by Federal Products Corp., 1144 Eddy St., Providence, R. I., has been improved by arranging to support the indicator by the back instead of by the stem. Heretofore all indicators on this particular model have been held by the stem, but it is recommended that they be held by



the back because of the liability of binding the rack spindle. Base of this gage has been redesigned. It now has three feet instead of four, assuring a positive footing wherever the gage may be placed. Holes are provided in the base through which an angle attachment can be fitted for holding cylindrical work, or to act as a stop for work placed in the platen.

With this gage a No. AN-4 attachment, shown in the inset, can be furnished where a fine setting or the indicator will be of advantage. This bracket allows adjustment of ten to twenty thousandths of an inch. With the regular No. NB-60 gage, a "E" size, 3⅝ in. diameter indicator is furnished. When the No. AN-4 attachment is used a "D" or 2¾ in. diameter indicator is furnished. Both of these indicators are graduated to 0.0001 in. Other indicators can be substituted, if desired.

Ajax 8-in. Capacity Upsetting Machine Features One-Piece Integral Frame



Weighing 470,000 lb., this huge 8-in. upsetting and forging machine designed and built by the Ajax Mfg. Co., Chardon Rd., Cleveland, Ohio, has a one-piece integral frame without joint between crankshaft and dies. This arrangement provides great longitudinal rigidity. The machine was built to accommodate dies 46 in. high, so that dies with as many as four progressive operations for fabricating heavy forgings can be handled entirely within the die seat of this machine. The dies open sufficiently to permit transferring large work up and down between the various passes without interference.

The machine is driven by a 150 hp. motor through V-belts to a flywheel and air clutch assembly weighing approximately 35,000 lb. that is carried on anti-friction bearings. In spite of its large size, this machine is easy to operate. It requires no more effort on the part of the operator than a machine of ordinary size. The tripping of a small foot valve causes the air clutch to engage.

The machine is fed from furnaces on either side by means of cranes. Each crane transports heated stock from the furnace to the throat or feed gap, supports the bar in position between the dies for the operator, and returns the bar to the furnace for heating for the next forging. A special sixteen-wheel railroad flat car with double trucks was required to ship this machine, even though it had been disassembled.

Stow Flexible Shaft Units Now are Truck Mounted

A flexible shaft machine designed for easy portability around the factory floor or yard has been announced by Stow Mfg. Co., Inc., Binghamton, N. Y. It makes use of a two-wheel truck mounting which carries either the direct-connected motor-and-shaft unit or the multi-speed, belt-and-pulley driven unit. The truck base is of heavy cast-iron construction that carries two 8 in. wheels and has an

(Advertisement)

Carboloy Sheet Metal Draw Dies Still Operating After 7,200,000 Pieces

An example of the service obtained from Carboloy sheet metal draw dies is illustrated in an application at a mid-western plant. As shown below, a steel ferrule is formed in 10 passes from blank to finished ferrule.

Carboloy cemented carbide dies are used for 8 of the 10 passes. Dies have been in use continuously since April 1937, have produced 7,200,000 pieces since that time and are still operating. Carboloy die sizes in use for sheet metal drawing range up to 6" I.D.

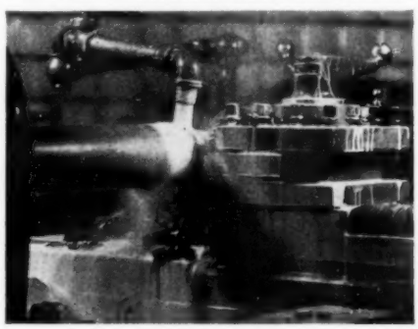
Many Uses For Carboloy In Form of Hollow Cylinders

Many industries having problems of rapid abrasive wear on localized areas of machine parts, tools, etc., have found numerous uses for Carboloy in the shape of hollow cylinders. A few of the many applications in use today are: Cam rollers, valve seats,

spindle bearings, ring gage and large plug gage inserts, workrest bushings, burnishing punch bushings, punch die inserts, etc. When requesting information, state sizes, probable quantities, type of job and finish required.

Carboloy Tool Removes 38 Cu. In. Per Min. On S.A.E. 2350 Spindle Job at Monarch

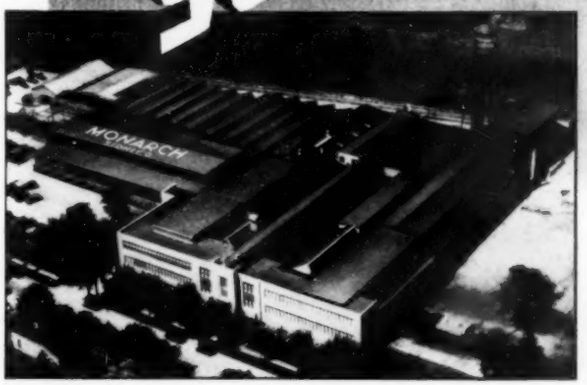
One of the 2000 Carboloy tool applications at Monarch Machine Tool Company is the turning of S.A.E. 2350 spindle forgings, 36" long, 4" diameter. Set up on a 20" Monarch lathe equipped with 30 H.P. motor,



a Carboloy tool turns this forging at 300 f.p.m., feed of .020" per revolution. Maximum depth of cut 5/8". The operation is completed in eight minutes, removing 38 cubic inches of metal per minute. High speed steel tools formerly required 24 minutes. The Carboloy tool completes five forgings between grinds.

Recent Carboloy Literature Bulletin GT-120 containing complete data on steel cutting with Carboloy tools. Booklet GT-403 describing the general purpose use of Carboloy tools on 1500 small-lot applications at Warner & Swasey Company.

MACHINING PRODUCTION SOARED 33% at MONARCH on 2,000 small-lot jobs . . .



Does it pay to use Carboloy tools for small-lot, diversified machining work?

Can you use Carboloy tools broadly throughout a plant for every-day-run-of-the-mine applications?

Ask Monarch!

In the Monarch plant you'll find Carboloy tools used as *general purpose* tools for 75% of all turning, facing, boring on cast iron and STEEL, and 100% of all end milling and face milling on cast iron and semi-steel.

Again!
General-Purpose Use of Carboloy *PAYS DIVIDENDS!*

Today, Monarch will tell you that Carboloy tools have stepped up machining production an average of more than 33%, and stepped down machining costs an average of 25% on more than 2,000 small-lot jobs in the Monarch plant.

How did Monarch get these quantity-production results on small-lot work? The method is surprisingly easy! It's a method *any* plant can use to increase production and reduce costs on diversified, short-run jobs. Write for the FACTS!

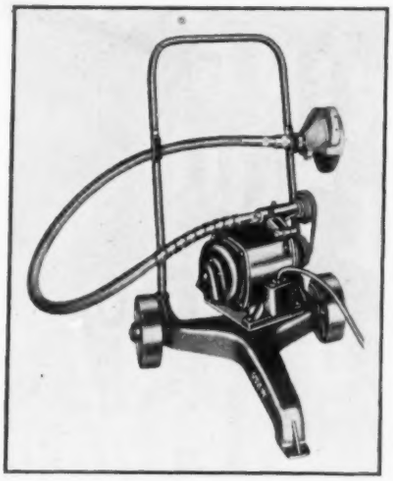
CARBOLOY COMPANY, INC., 11147 E. 8-Mile Blvd., DETROIT, MICHIGAN

CHICAGO • CLEVELAND • NEWARK • PITTSBURGH • PHILADELPHIA • WORCESTER, MASS.

CARBOLOY

TUNGSTEN CARBIDE—TANTALUM CARBIDE—TITANIUM CARBIDE

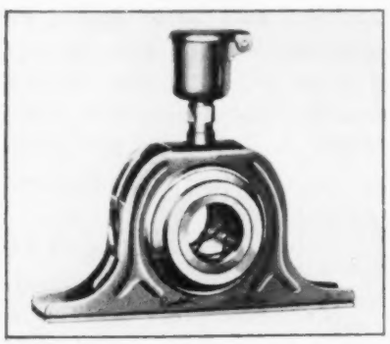
FOR CUTTING, DRAWING, SHAPING, EXTRUDING METALS AND NON-METALLICS
★ FOR REDUCING WEAR ON EQUIPMENT OR PRODUCTS YOU USE OR MAKE ★



extending leg to provide three-point stability, even on the roughest surfaces. A ball bearing swivel is provided so that even the heaviest type of unit may be turned easily in a horizontal direction. This model is especially recommended for heavy work of all types.

Randall Pillow-Block Has One-Piece Housing

A large pillow block having a one-piece steel housing has been made available by Randall Graphite Products Corp., 609-613 W. Lake St., Chicago, Ill., for shafts of $1\frac{1}{16}$ to $1\frac{5}{16}$ in. diameters. Design of this pillow-block results in a quiet, light-weight bearing which is simple to install.



It features selective mounting positions, constant self-alignment, self-lubrication with lighter weight. The entire assembly consists of only three parts: the one-piece steel housing, a machined cast-iron ball with large oil reservoir, and a bronze bushing with graphite filled grooves to provide ample lubrication.

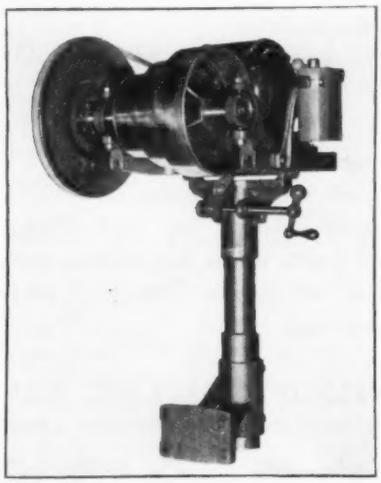
Cramer Automatic Timers Operate After Preset Time

Automatic reset Type RS timers, offered by the R. W. Cramer Co., Centerbrook, Conn., are designed for use on alternating current to close or open a circuit, after an adjustable preset time, and instantly return to the starting position ready to repeat their cycle of operation upon reclosure of the starting button. The switch is totally inclosed and has a definite snap-action and positive lock in both operating positions. The timers consist essentially of a switch-unit, actuated by an operating arm which is driven in one direction by a self-starting synchronous motor with inclosed magnetically operated clutch

gear, and reset in the opposite direction by means of a coil spring dampened to assure smoth operation and minimum wear. The housing is provided with a time dial, a readily adjusted time pointer, and a starting button which controls operation of the timer.

"Modern" Individual Drives Fit Belt-Driven Machines

A series of fifteen models of "Modern" individual motor drive has been developed by Quality Hardware & Machine Co., 5847 No. Ravenswood Ave., Chicago, Ill., for belt-driven lathes, shapers, milling machines, turret lathes and other machine tools. Each drive is a complete, self-contained unit, including motor mounting. V-



belts are used for the drive to the countershaft, which runs in two ball bearings, the final drive to the cone pulley on the machine being by standard flat belt. A crank-and-screw control that actuates a cam working directly against the base of the motor and drive shaft mounting provides a wide range of adjustment. This column-mounted type drive is supplemented by a new series of drives for mounting on punch presses, power hacksaws, drill presses and similar units.

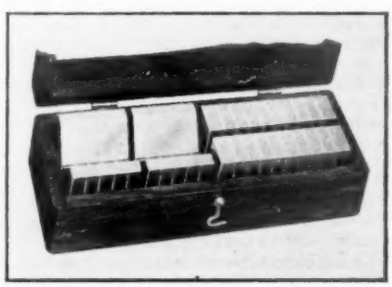
Continental Universal Gage Measures Heights and Depths

The "Doall" height and depth gage announced by Continental Machines, Inc., 1301 Washington Ave. S., Minneapolis, Minn., is furnished with rods which measure up to 6 in. As a depth gage or as an inside parallel surface gage, the measuring rods are locked into accurate position after the measurement is taken. Accurate depth obtained is then read by a micrometer. The gage also can be used for height

measurements, in which case the special height pin is inserted in the gage in place of measuring rods. With the height attachment, the gage can be used for marking accurate layout lines. The gage is arranged so that a three-point contact is maintained whether it is used as a height or a depth gage, or for measuring inside parallel surfaces.

Scherr Offers "Magne-Blox" For Surface Grinding Work

The George Scherr Co., 128 Lafayette St., New York, N. Y., offers the "Magne-Blox" set of magnetic parallels and V-blocks for use with magnetic chucks. Made of alternate laminations of brass and iron of high



magnetic capacity, this set consists of two parallels measuring 1x1¾x3¾ in. and two V-blocks measuring 1¾x 2⅜x1⅞ in. The set is intended especially for surface grinding operations on pieces which, because of their form, cannot be held directly on the face of the magnetic chuck.

Westinghouse Luminaire Uses Two Fluorescent Lamps

A 48-in. twin-lamp "RLM" fluorescent luminaire with spread distribution designed for general or supplementary lighting in low bay industrial areas is offered by Westinghouse Electric & Mfg. Co., Cleveland, Ohio. The units are furnished wired complete with hood, reflector, lamp holder, lamp starter and ballast equipment for 110-125, 199-216, or 220-250 volt circuits. The hood is of sheet-steel hinged to the reflector, with knockouts at each end to provide for end-to-end mounting and straight-through wiring. Reflector is white porcelain enameled steel, and has an over-all efficiency of 78 per cent with a cutoff of 72½ deg. from vertical normal to the lamp.

Staynew Filter Cleans Air For Delicate Apparatus

The Model AAPHS "Protectomotor" air filter announced by the Staynew Filter Corp., 25 Leighton Ave., Rochester, N. Y., is designed primarily for the complete removal of the slightest traces of oil from compressed air lines. In addition, it effectively prevents the passage of moisture as well as dust, dirt, pipe scale or other foreign matter commonly found in pipe lines for air supply. It is especially suited for cleaning air used in pneumatic control instruments. The lower portion of the shell of this filter is removed easily for inspection or cleaning.

Wright-Austin Float Traps Drain Compressed Air Lines

Developed for draining moisture and oil from all kinds of compressed air equipment, the No. 23-AC float trap offered by Wright-Austin Co., 315 W. Woodbridge St., Detroit, Mich., never needs priming or filling with water by hand at any time. It handles the thick, oily emulsion from cylinder lubrication easily because of the large outward opening valve. It is made with three sizes of pipe connections; ¾, 1 and 1¼ in. being standard. Net weight is 25 lb.

G. E. Fluorescent Luminaire Made for Industrial Uses

Development of a two-tube "RF" fluorescent luminaire especially suited for industrial areas has been announced by General Electric Co., Nela Park, Cleveland, Ohio. An out-

5 REASONS FOR USING . .

Ryerson Certified Steels

1 **Every pound of steel in Ryerson stock is certified, prime quality.** No seconds are ever carried. Ryerson has built up complete stocks of these better steels in every classification—steels made to narrow, close-range specifications that assure better working qualities. For example: Ryerson Hot Rolled Bands will bend flat on themselves either with or against the grain; Continuous Mill Sheets in Ryerson stock are rolled from only the best part of the coil to make sure of flatness, accurate gauge and size; structural shapes and plates meet A.S.T.M. specifications not simply manufacturers standards; machine and carriage bolts have cut—not rolled—threads, etc.

2 **Ryerson Certified Steels cut labor costs.** These better steels are free from hard or soft spots and can be depended upon for uniform working and forming qualities. Spoilage and breakage are reduced, proving Ryerson Certified Steels are superior for close-tolerance work, automatic equipment, and production line applications.

3 **Ryerson stocks are complete and diversified.** You save time, trouble and money by concentrating all steel requirements with this one dependable source of supply. Stocks include everything from structurals to stainless—from mechanical tubing to foundation bolts. Many special analyses and unusual sizes are included in the wide range of Certified Steel products in stock for Immediate Shipment.

4 **The special quality control plan on Ryerson Certified Alloy Steels** assures uniform heat treatment response and eliminates testing, experimenting and reheating. Complete chemical and physical properties, and the exact heat treating characteristics of each bar are sent with the steel to guide the heat treater in quickly securing any desired result.

5 **Ryerson Certified Steels cost no more.** You pay no premium for the uniform high quality of Ryerson products. Rely on Ryerson. Stocks are ample, and prompt shipment is assured. If you do not have the Ryerson Stock List—the guide to Immediate Steel—we will gladly send a copy on request.

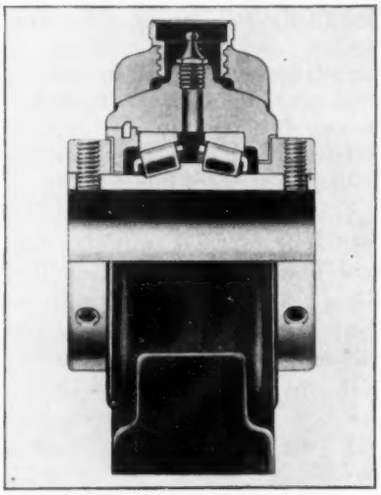
Joseph T. Ryerson & Son, Inc. Plants at: Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Philadelphia, Jersey City.

growth of the familiar Cooper Hewitt fluorescent Lamp, the fixture consists of a self-contained auxiliary mounted on a porcelain enamel reflector. It is rated at 200 watts and operates two 85-watt "RF" tubes each 58 in. long. These tubes have a combined initial rating of over 8,000 lumens. When mounted on 10 ft. centers, this unit will provide adequate industrial illumination.

The Lamp Department also has announced fluorescent lamps in two different colors, namely the original blue-white tube and a new white lamp. The latter, developing a color equivalent of approximately 8,000 deg. Kelvin, is designed to satisfy needs in industry where color is a prime factor. This new white tube, measuring 58 in. in length, is interchangeable with blue-white tubes on all Cooper Hewitt fluorescent lamps now in service.

Double Interlock Block Features Inclosed Bearing

The Dodge-Timken double interlock pillow block made by Dodge Mfg. Corp., Mishawaka, Ind., has been designed for simplified mounting on ordinary commercial shafting where less heavy loads are to be carried than those requiring the Dodge-Timken clamp sleeve type bearing. This

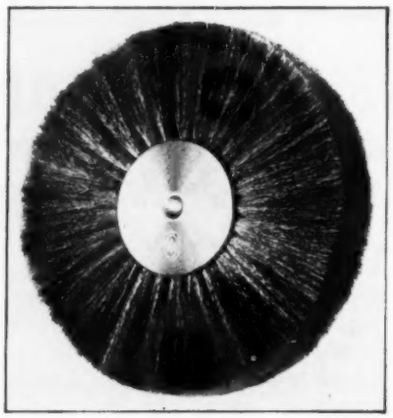


new pillow block uses a special duplex Timken roller bearing with long inner race-ring. This ring extends completely through the housing and provides a completely inclosed bearing. Mounting on the shaft is simple. Collars with two setscrews based at 120 deg. are placed on the outside of each end of the extended inner race-ring. These setscrews pass through unthreaded holes in the race-ring, bear directly on the shaft on the one side and clamp the race-ring directly against the shaft on the other side.

The pillow block is made in both expansion and non-expansion types. In the latter type the inner unit is mounted in a two-piece cast iron housing with the inside machined spherical to fit the outside of the inner unit. In the expansion type, the inner unit is mounted in a two-piece cast iron outer housing with the inside machined with a straight cylindrical bore to fit the outside of the inner unit. Adequate labyrinth seals are provided to retain lubricant and to protect bearings against foreign material. These pillow blocks are available for shaft sizes from 1⅜ to 5 in. in both types.

H.-Van W.-M. Announces "Metl-Hub" Scratch Brushes

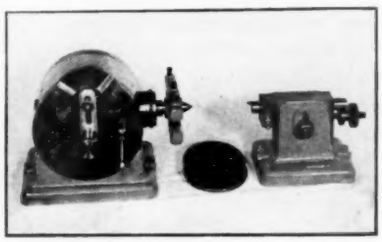
The "Metl-Hub" scratch brush perfected by the Hanson-Van Winkle-Munning Co., Matawan, N. J., has a one-piece circular metal hub of light-



weight alloy. Face of the hub permits the drilling of holes for the brush tufts close to the edge of the block, thus eliminating most of the projecting shoulder and lessening danger of the operator striking the work against this shoulder. The metal hub, because of its high strength compared with wood, is of small size. Holes for the tufts are spaced automatically, drilled and countersunk by machine to give the tuft a firm seat in the metal block. Tufts are locked into the hub by special methods. These brushes will handle all types of wet work, as there is no danger of warping or splitting the hub. They are made in all diameters with any number of rows and in a variety of hub and arbor hole sizes. Steel, brass, and nickel-silver wire may be used, as well as Tampico bristle and hair.

L-W Dividing Heads Have Worm Adjustment

Models AU and BP universal dividing heads announced by L-W Chuck Co., Toledo, Ohio, will swing 11 in. Headstock spindle is bored for No. 10 B & S taper. Threaded nose of spindle is 2¼-in. diameter. Supplied in either right- or left-hand styles, the Model BP head weighs 125 lb. The Model AU full-universal head can be arranged for spiral and helical cutting, and for differential indexing. Weight of this head is 200 lb. Both heads have a large diameter 40-to-1 ratio accurately generated worm wheel, and each is furnished with a heavy-duty tailstock and with three



index plates which divide all numbers to 50 and even numbers to 100, with the exception of 96-T. The index chart furnished gives all divisions obtainable to 380.

NEW MATERIALS

Westinghouse Alloy Has High Strength When Hot

"K-42-B" alloy developed by the Westinghouse Research Laboratory, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is claimed to be stronger than any known steel. It contains only 7 per cent iron. One of the principal features of this alloy is that it will retain its strength of temperatures higher than 2,000 F. The result of almost seven years of work by research metallurgist P. H. Brace, K-42-B is a first cousin of "Konal" alloy, a practical substitute for platinum in oxide-coated radio tube filaments.

The new K-42-B alloy is stronger at 1,100 F. than ordinary low carbon steel at room temperature. It has a low damping coefficient—or in other words, it retains its elasticity—at such elevated temperatures. Almost half of this alloy is nickel; about a quarter is cobalt. It has other components, including chromium, titanium, and iron. Production of the metal on a commercial scale is known to be practical, but its first cost will be high and its immediate uses are expected to be those of a special-purpose alloy for dies, valves, steam fittings, possibly turbine blades, or other applications requiring temperature-resistant metals.

This alloy "creeps" a great deal less than other metals in its class. Sample rods of the metal were loaded in tension to produce a stress of 20,000 lb. per sq. in. and heated in an electric creep-testing furnace for 6,000 hr. at a constant temperature of 1,000 F. At the end of the test, K-42-B showed a yield of only 0.0001 in. for each inch of its length, and most of this had taken place during the first few hours. Under the same conditions a sample of high-strength nickel-chromium steel yielded 100 times as much.

TO THE EDITOR

Senator O'Mahoney Explains

Senator Joseph C. O'Mahoney, chairman of the TNEC and sponsor of a hotly discussed bill widely interpreted as providing "a tax on machines," replies to an AMERICAN MACHINIST *editorial condemning it:*

Dear Sir:

. . . The measure, even as it was drafted, was not a tax on machines. It provided a specific formula for helping employers to make jobs, but it did not contain any formula for taxing machines as such. The basis for the contribution payment is not in the slightest degree measured by the number or kind of machines used. It is measured solely by the "non-labor markup." This markup would be much more likely to be a result of price manipulation than of anything else.

Of course, in the past there have been specific proposals for taxes on machines. I have never given my support to any of them because of the obvious danger that they might in fact be an obstacle to progress. My whole philosophy is that production ought to be increased but that the opportunities for increased production and for creating new markets for the products of improved technology are measured by the capacity of the masses of the people to purchase the products of industry.

Certainly this has been demonstrated by the history of the automobile industry. It has grown great precisely because the prices have been so reduced as to bring automobiles within the purchasing power of an ever-increasing proportion of the population. Much of this purchasing power is fictitious because it is based upon installment selling or the mortgaging by the purchaser of his future income. This has been followed by the whole difficult problem of interest, foreclosures and repossession, which in turn create new difficulties for the retail seller who has to dispose of used cars. All of this, to my mind, means one thing—namely, that the open door to industry and to the development of the machine lies in the stimulation of the purchasing power of the masses.

It seems to me elementary that industry must support itself. It can not be supported by government unless we are willing to see the development of the totalitarian state. Therefore, we must find the formula by which industry, rather than government, will attempt to solve the unemployment problem. That is what I am trying to do. Millions of people on relief, struggling along with inadequate WPA wages and living from hand to mouth by the purchase of orange and blue stamps, will not create the market that the machine needs. We have to put these people to work at real wages if we are going to aid science and invention to develop the unlimited opportunities which are presented by nature.

Far from being an enemy of the machine, I conceive myself to be a friend. There is no substitute in the world for work. The opportunity to work is one of our most precious rights; yet, curiously enough, Senator Norris, in criticizing my proposal, suggested as an alternative an extraordinary limitation upon the right of man to work. Do you not think that there are some elements of impeding progress in a proposal of that kind?

Sincerely yours,
JOSEPH C. O'MAHONEY

Stripped of legal terminology, Senator O'Mahoney's bill boils down to this:

Every manufacturer would pay a tax equal to a certain percentage of his "labor-differential income." ("Labor-differential income" is gross income minus cost of supplies and materials and minus all wages under $3,000 a year.) Against this tax the manufacturer would be credited with a certain percentage of all wages under $3,000 a year.

Thus, as wages increase in their proportion to total income, the tax would decrease. Substitution of machine for human labor (in an attempt to cut costs, which the Senator favors) would, however, decrease the proportion of wages to income and therefore increase the tax. The bill, then, inevitably constitutes an indirect tax on mechanization, on efficiency, even though its purpose ("To reduce unemployment") may be vastly different.

It must further be emphasized that the two percentages mentioned in the bill are not necessarily the same. Juggling their relationship would provide flexibility which could make the measure "just another tax" or a veritable stranglehold on technological progress.—The Editors.

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Drawings That Sell Machines

The builder of one well-known machine tool makes demonstration drawings with the various parts colored in a striking manner. These stand out so vividly that one not familiar with the operation of the machine can readily see the relation of the parts to the work. They make it easier to show the advantages of the machine, and the builder feels he has helped make customers out of doubtful prospects.

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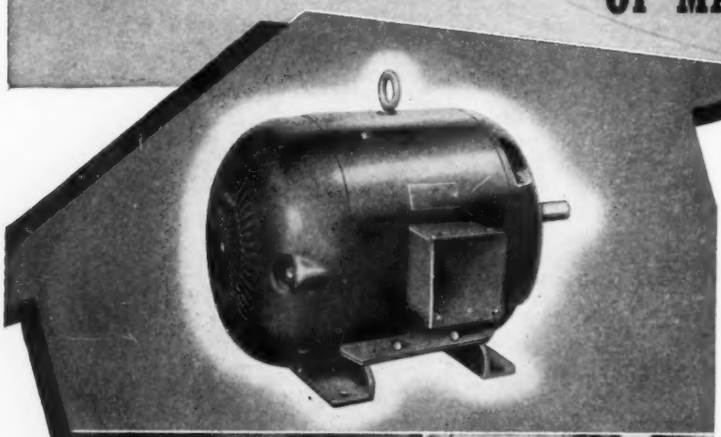

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